

## Supplementary Text

### Calculating Direct and Indirect Effects

Substituting equations (2) through (5) into equation (1) yields to:

$$HA_i = f \{C_i, E [C_i, X_i], I [C_i, E(C_i, X_i), X_i], W [C_i, E(C_i, X_i), X_i], HH [C_i, E(C_i, X_i), I [C_i, E(C_i, X_i), X_i], W [C_i, E(C_i, X_i), X_i], X_i], Z_i\} \quad (A1)$$

The healthy aging production function equation shown in equation A1 can be estimated as follows:

$$HA_i = \gamma^0 + \gamma^c C_i + \gamma^{edu} E [C_i, X_i] + \gamma^{inc} I [C_i, E(C_i, X_i), X_i] + \gamma^{wl} W [C_i, E(C_i, X_i), X_i] + \gamma^{hh} HH [C_i, E(C_i, X_i), I [C_i, E(C_i, X_i), X_i], W [C_i, E(C_i, X_i), X_i], X_i] + \gamma^z Z_i + \varepsilon_i \quad (A2)$$

The direct association of a unit change in childhood factors on healthy aging is  $\gamma^c$ , and this is what most prior studies conventionally estimate as the association between childhood factors and healthy aging controlling for income, wealth, health behavior, etc. However, the total effects (marginal product) of childhood factors on healthy aging is the sum of the direct effect ( $\gamma^c$ ) and the indirect effects that operates through mid-life mediators. In order to obtain the total effects of each childhood characteristics on healthy aging we have to take the full derivative of the production function with respect to that childhood characteristic, simply shown as:

$$\frac{\partial HA_i}{\partial C_i} = \frac{\partial f\{\}}{\partial C_i} \quad (A3)$$

The full set of direct and indirect effects of childhood factors can be obtained by taking a full derivative of the health production function (equation A1) with respect to  $C_i$ .

$$\begin{aligned}
\frac{\partial HA_i}{\partial C_i} &= \frac{\partial f}{\partial C_i} + \frac{\partial f}{\partial Edu_i} \frac{\partial E}{\partial C_i} + \frac{\partial f}{\partial Inc_i} \left[ \frac{\partial I}{\partial C_i} + \frac{\partial I}{\partial Edu_i} \frac{\partial E}{\partial C_i} \right] + \frac{\partial f}{\partial W_i} \left[ \frac{\partial W}{\partial C_i} + \frac{\partial W}{\partial Edu_i} \frac{\partial E}{\partial C_i} \right] + \frac{\partial f}{\partial HH_i} \left[ \frac{\partial HH}{\partial C_i} + \frac{\partial HH}{\partial E_i} \frac{\partial E}{\partial C_i} + \right. \\
&\quad \left. \frac{\partial HH}{\partial Inc} \left( \frac{\partial I}{\partial C_i} + \frac{\partial I}{\partial Edu_i} \frac{\partial E}{\partial C_i} \right) + \frac{\partial HH}{\partial W_i} \left( \frac{\partial W}{\partial C_i} + \frac{\partial W}{\partial Edu_i} \frac{\partial E}{\partial C_i} \right) \right] \tag{A4}
\end{aligned}$$

Rearranging equation A4 yields to equation 6 given in the text, which separates the direct and four indirect components of the total effects of on  $C_i$  on healthy aging.

Supplementary Tables

Supplemental Table 1: Variable Definitions and Descriptive Statistics for the Sample of Adults Ages 65+ (N=7,355).

	<u>Definition</u>	<u>Mean/ %</u>	<u>SE / N</u>
<b><u>Dependent variables</u></b>			
Healthy Aging		0.059	0.010
major disease	high blood pressure, diabetes, cancer, lung disease, heart disease, stroke, psychiatric problems, arthritis, and depression	2.559	0.022
disabilities	Activities of daily living, difficulty: walking across a room, dressing, bathing/ showering, eating, and getting in/out bed /Instrumental activities of daily living , difficulty: using the phone, taking medication, managing money, shopping for grocery, preparing meals	0.516	0.022
ADL/IADL			
physical functioning	walking one block, walking several blocks, climbing one flight of stairs, climbing several flights of stairs, lifting or carrying items weighing more than 10 lbs., stooping, kneeling or crouching, and pulling or pushing large objects	2.163	0.032
cognitive functioning	Telephone Interview of Cognitive Status (TICS)	22.001	0.085
social engagement	frequency of visiting people in or near the facility/any of the neighbors just to chat or for a social visit	2.765	0.023

Education	years of education [1-17+]	12.838	0.070
log(income)	annual household income	10.495	0.023
Log(wealth)	wealth	11.844	0.051
Health Habits	Healthy habits index score [0-10]	4.968	0.030
<b>Smoking Habit</b>			
	Current smoker	8.32%	612
	Former smoker	47.98%	3,529
	Never smoker	43.70%	3,214
<b>Body Mass Index</b>			
	Obese	BMI > 30	29.39% 2,162
	Overweight	25 < BMI < 30	39.36% 2,895
	Normal / underweight	BMI < 25	31.25% 2,298
<b>Level of weekly exercise</b>			
	Never		58.76% 4,322
	1-3 times a month		8.81% 648
	Once a week		8.58% 631
	More than once weekly		21.48% 1,580
	Every day		2.37% 174
<b>Drinking Habit</b>			
	High-Risk		5.58% 410
	Low-Rsik		29.19% 2,147
	Not at risk / Non drinker		65.23% 4,798
<b><u>Biological factors</u></b>			
	Mother	78	0.190
	Father	72	0.196

## **Childhood circumstances**

### Father's Education Level

At least high school (reference category)	32.88%	2,418
Less than high school	56.08%	4,124
Not reported	11.04%	812

### Mother's Education Level

At least high school (reference category)	39.12%	2,878
Less than high school	53.59%	3,942
Not reported	7.29%	536

### self-rated health as a child

Excellent	53.47%	3,932
Very good	24.41%	1,795
Good (reference category)	16.38%	1,204
Fair	4.38%	322
Poor	1.38%	101

### Self-rated SES as a child

Above average	6.42%	472
Average or varying	63.14%	4,717
Below average	29.44%	2,166

## **Socio-demographics**

### Age Cohort

65 - 75 (reference category)	56.25%	4,137
75 - 85	33.54%	2,467
85+	10.21%	751

### Gender

Male	(reference category)	42.03%	3,091
Female		57.97%	4,264
<b>Marital Status</b>			
Married /partnered	(reference category)	59.15%	4,350
Separated / Divorced		12.23%	900
Widowed		25.18%	1,852
Never Married		3.44%	253
<b>Race /ethnicity</b>			
White	(reference category)	84.76%	6,234
Black		7.28%	535
Hispanic		5.78%	425
Other		2.18%	160
<b>Census Region</b>			
Northeast		16.89%	1,243
Midwest		26.44%	1,945
South	(reference category)	36.09%	2,654
West		20.45%	1,504
Other		0.13%	9
<b>Insurance</b>			
Medicare	(reference category)	61.14%	4,497
Medicare & Medicaid		5.90%	434
Medicare & Private		29.24%	2,150
Other or No Insurance		3.73%	274

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Data are from 2010 Health and Retirement Study (HRS).

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75 - 84	-0.097	0.076	-	0.186***	0.026	0.104	0.069	0.179***	0.048	-	0.168***	0.017	-	0.202***	0.019	
85 <sup>+</sup>	-0.078	0.125	-	-0.21***	0.035	0.052	0.122	0.439***	0.075	-	0.389***	0.030	-	0.474***	0.026	
Gender																
Female	-0.299***	0.063	-	0.096***	0.017	-0.083	0.052	0.232***	0.046	-	0.049***	0.014	-	0.035***	0.013	
Marital Status <sup>h</sup>																
Separated or divorced			-	0.746***	0.043	-	1.755***	0.113	-	0.115***	0.069	0.003	0.023	-0.018	0.027	
Widowed			-	0.613***	0.028	-	0.941***	0.069	-0.051	0.056	0.008	0.016	-0.021	0.016		
Never Married			-	0.758***	0.087	-	1.485***	0.223	0.117	0.141	0.098**	0.046	0.113***	0.043		
Race / Ethnicity <sup>k</sup>																
African American	-0.727***	0.151	-	0.306***	0.039	-	1.393***	0.105	0.167**	0.072	-	0.136***	0.025	-	0.101***	0.024
Hispanic	-3.509***	0.326	-	-0.38***	0.070	-	1.302***	0.209	0.346***	0.095	-0.063*	0.033	-0.042	0.035		
Other	0.023	0.367	-	0.143***	0.112	-	0.872***	0.209	0.449***	0.157	-0.024	0.052	0.004	0.052		
Census Region <sup>m</sup>																
Midwest											-0.014	0.014	-0.012	0.020		
South											-0.026	0.016	0.048***	0.019		
West											-0.018	0.018	-0.007	0.024		
Insurance <sup>q</sup>																
Medicare & Medicaid											-	0.154***	0.033	-	0.162***	0.036
Medicare & Private											0.011	0.012	0.036***	0.010		
Other or No Insurance											0.016	0.032	0.023	0.033		
Intercept Term	12.164***	0.116	9.695***	0.100	9.437***	0.175	2.825***	0.313	-	1.365***	0.116	-	-	1.515***	0.131	

<sup>a</sup> Parent's current age or age at death

Reference Groups:<sup>b</sup> about average, <sup>c</sup> good, <sup>d</sup> more than high school, <sup>e</sup> aged 65-74, <sup>h</sup> married/partnered, <sup>k</sup> white, <sup>m</sup> northeast, <sup>q</sup> medicare. \*p<0.1, \*\*p<0.05, \*\*\*p<0.01. The p-value corresponds to a test of difference from zero. Standard errors are reported in parentheses and were calculated using bootstrapping methods. All estimates are weighted to represent the non-institutionalized U.S. population, ages 65 and older, based on sampling weights of the 2010 Health and Retirement Survey.



Alternative Definition of Healthy Aging (not considering cognition in the outcome measure)

Supplemental Table 3. Specific Indirect, Direct, and Total Effects of Childhood Characteristics on Alternative Healthy Aging Scores (excluding cognition) among Men Ages 65+, Year 2010 (8,295)

Childhood Factors ( $C_j$ )	Indirect through				Direct	Total
	Education(E)	Income(I)	Wealth(W)	Health Behaviors (HB)		
<b>Childhood Socioeconomic Status <sup>a</sup></b>						
Above average	0.026***(0.005)	0.001(0.002)	0.006(0.005)	0.011(0.008)	-0.011(0.032)	0.033(0.037)
Below average	-0.013***(0.003)	0.001(0.001)	-0.001(0.003)	0.000(0.004)	-0.061***(0.019)	-0.073***(0.020)
<b>Childhood Health <sup>b</sup></b>						
Excellent	0.025***(0.004)	0.002(0.001)	0.011***(0.004)	0.096***(0.023)	-0.001(0.006)	0.132***(0.024)
Very Good	0.012***(0.003)	0.001(0.001)	0.009**(0.004)	-0.002(0.006)	0.014(0.025)	0.035(0.026)
Fair	0.004(0.006)	0.000(0.001)	-0.006(0.008)	-0.002(0.009)	-0.083**(0.039)	-0.088**(0.042)
Poor	0.004(0.009)	-0.005(0.004)	-0.025**(0.011)	-0.008(0.013)	-0.099(0.077)	-0.134*(0.079)
<b>Parental Education <sup>c</sup></b>						
Father More than high school	0.025***(0.004)	0.003*(0.002)	0.003(0.003)	0.003(0.005)	0.013(0.017)	0.045***(0.018)
Mother More than high school	0.028***(0.004)	0.002*(0.001)	0.002(0.003)	-0.002(0.004)	0.043**(0.017)	0.072***(0.017)

Reference Groups: <sup>a</sup>average, <sup>b</sup>good, <sup>c</sup>less than high school. \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ . The p-value corresponds to a test of difference from zero. Standard errors are reported in parentheses and were calculated using bootstrapping methods. All estimates are weighted to represent the non-institutionalized U.S. population, ages 65 and older, based on sampling weights of the 2010 Health and Retirement Survey.

Supplemental Table 4. Estimated Production Function for Healthy Aging and Estimated Models for Educational Attainments, Income, Wealth and Health Behaviors among Adults Ages 65+, Based on the Four Indirect Model, (8,295).

<b>Inputs</b>	Education	Income	Wealth	Health Behaviors	Healthy Aging 2010
<b><u>Biological Factors</u></b>					
Mother <sup>a</sup>					0.001**(0.000)
Father <sup>a</sup>					0.000(0.000)
<b><u>Childhood circumstances</u></b>					
Childhood SES <sup>b</sup>					
Above Average	0.945*** (0.140)	0.042(0.058)	0.127(0.102)	0.139(0.110)	-0.011(0.032)
Below Average	-0.458*** (0.058)	0.037*(0.021)	-0.016(0.067)	-0.003(0.049)	-0.061*** (0.019)
Self-rated health as a child <sup>c</sup>					
Excellent	0.897*** (0.107)	0.071** (0.028)	0.245*** (0.091)	-0.014(0.077)	0.096*** (0.023)
Very Good	0.444*** (0.093)	0.023(0.031)	0.21** (0.086)	-0.023(0.081)	0.014(0.025)
Fair	0.149(0.218)	-0.019(0.054)	-0.143(0.172)	-0.032(0.120)	-0.083** (0.039)
Poor	0.142(0.313)	-0.229*** (0.086)	-0.568** (0.251)	-0.110(0.166)	-0.099(0.077)
Father's Education Level <sup>d</sup>					
Not reported	-0.491*** (0.131)	-0.017(0.036)	-0.234** (0.119)	-0.052(0.078)	-0.025(0.029)
More than high school	0.886*** (0.090)	0.105*** (0.030)	0.069(0.069)	0.033(0.060)	0.013(0.017)
Mother's Education Level <sup>d</sup>					
Not reported	-0.682*** (0.173)	-0.025(0.038)	-0.38*** (0.132)	0.057(0.074)	0.040(0.033)
More than high school	0.993*** (0.081)	0.099*** (0.032)	0.044(0.064)	-0.031(0.056)	0.043** (0.017)
<b><u>Mid and later life circumstances</u></b>					
Education		0.089*** (0.007)	0.228*** (0.010)	0.038*** (0.008)	0.013*** (0.004)
Ln(income)				0.007(0.027)	0.023** (0.011)
Ln(wealth)				0.112*** (0.011)	0.036*** (0.004)
Health Behaviors					0.076*** (0.004)
<b><u>Socio-demographics</u></b>					
Age Cohort <sup>g</sup>					
75 - 84	-0.097(0.076)	-0.186*** (0.026)	0.104(0.069)	0.18*** (0.048)	-0.132*** (0.018)

85 <sup>+</sup>	-0.078(0.125)	-0.21*** (0.035)	0.052(0.122)	0.442*** (0.075)	-0.319*** (0.034)
Gender					
Female	-0.299*** (0.063)	-0.096*** (0.017)	-0.083(0.052)	0.233*** (0.046)	-0.113*** (0.018)
Marital Status <sup>h</sup>					
Separated or divorced		-0.746*** (0.043)	-1.755*** (0.113)	-0.113(0.069)	-0.023(0.027)
Widowed		-0.613*** (0.028)	-0.942*** (0.069)	-0.051(0.056)	-0.015(0.019)
Never Married		-0.758*** (0.087)	-1.485*** (0.223)	0.118(0.141)	0.092* (0.056)
Race / Ethnicity <sup>k</sup>					
African American	-0.727*** (0.151)	-0.306*** (0.039)	-1.393*** (0.105)	0.170** (0.072)	-0.055* (0.031)
Hispanic	-3.509*** (0.326)	-0.38*** (0.070)	-1.302*** (0.209)	0.346*** (0.094)	-0.053(0.044)
Other	0.023(0.367)	-0.143(0.112)	-0.872*** (0.209)	0.449*** (0.157)	0.028(0.052)
Census Region <sup>m</sup>					
Midwest					-0.018(0.015)
South					-0.033* (0.019)
West					-0.018(0.020)
Insurance <sup>q</sup>					
Medicare & Medicaid					-0.166*** (0.038)
Medicare & Private					-0.005(0.017)
Other or No Insurance					0.032(0.038)
Intercept Term	6.578*** (0.177)	0.653*** (0.038)	4.691*** (0.140)	3.025*** (0.051)	0.306*** (0.009)

<sup>a</sup> Parent's current age or age at death

Reference Groups:<sup>b</sup> about average, <sup>c</sup> good, <sup>d</sup> more than high school, <sup>e</sup> aged 65-74, <sup>h</sup> married/partnered, <sup>k</sup> white, <sup>m</sup> northeast, <sup>q</sup> medicare. \*p<0.1, \*\*p<0.05, \*\*\*p<0.01. The p-value corresponds to a test of difference from zero. Standard errors are reported in parentheses and were calculated using bootstrapping methods. All estimates are weighted to represent the non-institutionalized U.S. population, ages 65 and older, based on sampling weights of the 2010 Health and Retirement Survey.