This PDF is a selection from a published volume from the National Bureau of Economic Research

Volume Title: Research Findings in the Economics of Aging

Volume Author/Editor: David A. Wise, editor

Volume Publisher: The University of Chicago Press

Volume ISBN: 0-226-90306-0

Volume URL: http://www.nber.org/books/wise08-1

Conference Dates: May 10-13, 2007

Publication Date: February 2010

Chapter Title: What's Past is Prologue: The Impact of Early Life Health and Circumstance on Health in Old Age

Chapter Author: Anne Case

Chapter URL: http://www.nber.org/chapters/c8202

Chapter pages in book: (211 - 228)

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What's Past Is Prologue
The Impact of Early Life Health and Circumstance on Health in Old Age

Anne Case

8.1 Introduction

Recent research finds that early life health has effects on health and economic circumstance from childhood through middle age. Controlling for parental income, education, and social class, this research finds that members of the 1958 and 1970 British birth cohorts who experienced poor health in childhood have significantly lower educational attainment, poorer health, and lower social status as adults. Childhood health and circumstance work both through their impact on initial adult health and economic status, and through the continuing direct effect of prenatal and childhood health in middle age (Case, Fertig, and Paxson 2005). Using height as a marker of childhood health and environment, recent research has also documented a strong and robust relationship between height and cognitive ability both in childhood and adulthood (Abbot et al. 1998; Case and Paxson 2008; Richards and Wadsworth 2004).

The impact of the uterine environment on health in middle age has been examined in a series of papers. (See, for example, Barker [1992]; Barker [1995]; Ravelli et al. [1998].) Many of these conclude that a poor uterine environment leaves individuals at risk for diabetes and cardiovascular dis-

Anne Case is the Alexander Stewart 1886 Professor of Economics and Public Affairs and a Professor of Economics and Public Affairs at the Woodrow Wilson School of Public and International Affairs and the Economics Department at Princeton University, and a research associate of the National Bureau of Economic Research.

This work was funded by NIA grant P01AG005842 and R01 AG20275-01. I thank David Cutler for suggesting the idea of looking at crops, and for sharing data on crop production in the early twentieth Century, and James P. Smith and participants at the NBER Aging Conference at the Boulders, 2007, for helpful comments. Lisa Vura-Weis provided expert research assistance.

ease in middle age, although others argue that there is little evidence that intrauterine health can explain chronic diseases in adulthood (Rasmussen 2001).

Less is known about the impact of early childhood environment on health in old age. In this chapter, we investigate the relationship between health and environment in early childhood and health and functioning in old age, using longitudinal data collected by the Health and Retirement Study (HRS). The HRS gives us an opportunity to document the lasting impact of early life environment on cohort members' quality of life, including self-reported health status, hypertension, difficulties with activities of daily living, and fine and gross motor skills.

We use two markers of health and early life environment. We document the extent to which height, as a measure of early life health and nutrition, is associated with more favorable outcomes in old age. We also investigate whether conditions that might have governed mother's nutrition while pregnant—such as the success of crop production while she was pregnant—are predictive of health in later life, and whether this marker of mother's nutrition can explain the association between height and health outcomes in old age. In addition, we examine the channels through which early life health and nutrition may affect health in later life, by introducing controls for educational attainment and occupational choice.

We find that height is protective of health in the HRS cohort. On average, taller men and women are significantly more likely to report themselves to be in better health, and are significantly less likely to report that a doctor has told them that they have hypertension. They report fewer difficulties with activities of daily living (ADLs), and better fine motor skills. Height appears to become more protective against hypertension, ADLs, and loss of fine motor skills as cohort members age, which is when cohort members face the largest risk of poor outcomes.

We find that height is predicted by the success of the corn crop in the year before birth, and that, taken together, height and corn production both have large and significant effects on HRS cohort member's health in old age. Corn production, which we argue is a broad marker for mother's nutrition, is protective against hypertension and the loss of fine motor skills and large muscle group skills. Corn production also appears to protect cohort members' abilities to carry out activities of daily living. For some markers of health in old age, the association between height and health can be explained by the association between height, education, and occupation. For other markers, we find a continued role for childhood conditions, even with controls for economic outcomes in adulthood.

We will proceed as follows. Section 8.2 presents our conceptual framework. Section 8.3 introduces the data we use on HRS cohort members, and documents the extent to which height is associated with more positive health outcomes in the cohort. Section 8.4 presents evidence that height is significantly correlated with greater educational attainment and higher status occupational choice. Section 8.5 documents the extent to which height and corn production—both markers of early life environment—are associated with better health outcomes for cohort members in later life, and examines the extent to which this can be explained by the association between height and early life nutrition on one hand, and educational and occupational outcomes on the other.

8.2 Conceptual Framework

Our interest in height and crop production stems from the information they carry about health and nutrition in early life, which may affect individuals throughout their lives. The model we use is based on a life course framework, which emphasizes the extent to which health in childhood has lasting effects on adult health—directly, through the impact of health itself, and indirectly, by restricting or enhancing educational attainment and life chances (Kuh and Wadsworth 1993; Case, Fertig, and Paxson 2005).

To illustrate ideas, we divide the life course into three time periods: early childhood (c), young adulthood (y), and older adulthood (a). Early childhood is the period in which height and childhood health are determined; young adulthood is the period when education is completed and an occupation is chosen; and older adulthood is the period under study here, in which HRS cohort members are age fifty and above. We express our measures of health in older adulthood (H_a) as a linear function of indicators of socioeconomic status in young adulthood, here educational attainment and occupational choice (e_y), and a vector of prenatal and childhood characteristics (C), and here adult height and crop production in the cohort member's geographical division in the year prior to the cohort member's birth:

$$H_a = \alpha_0 + e_y\alpha_e + C\alpha_C + \varepsilon_a. \tag{1}$$

Indicators of socioeconomic status in young adulthood are assumed to be functions of prenatal and childhood characteristics:

$$e_y = \gamma_{0e} + C\gamma_e + \nu_y. \tag{2}$$

Substitution of (2) into (1) yields reduced form equations for health in later adulthood.

Parameter estimates from (1) shed light on several issues. Estimates of α_C provide information on whether childhood circumstances have direct effects on outcomes in later adulthood, even controlling for earlier adult outcomes, or whether the effects of childhood circumstances in later adulthood work through their effects on outcomes in younger adulthood. The effects of early life health may only become apparent at older age (Barker 1992, 1995).

Alternatively, childhood circumstances may affect adult outcomes through their effects on educational attainment and social status early in adulthood. Under this alternative, α_C will be zero.

Estimates from (1) and (2) also provide information on the relationship between economic status and health in young and older adulthood. The cross effect of socioeconomic status on future health, α_e, is of particular in-terest. The large literature on the gradient—the positive association between health and economic status—contains a variety of hypotheses on how economic status affects health, and vice versa, with little consensus on which direction is more important (Smith 1999). Pathway models stress the idea that status in young adulthood influences future health (i.e., α_e nonzero), largely through the effects of low economic status on psychosocial stress (Marmot et al. 1991). This literature argues that childhood circumstance and health in early adulthood are generally not qualitatively as important as adult socioeconomic status in determining adult health (i.e., that α_C is relatively less important than α_e). Brunner et al. (1999) state, for example, that "whatever the salient features of the adult socioeconomic environment may be, it seems they are equally or more important than circumstances in childhood" (762) in determining cardiovascular risk among British civil servants.

We use estimates of (1) and (2) to examine which implications of these models find support in the HRS. Some important omissions must be highlighted before we begin. In principle, (1) could also include measures of health in early adulthood. The mechanisms through which early life health and circumstance affect health in old age may work through their effects on health in early adulthood. Unfortunately, markers for early adult health are limited in the HRS. To the extent that we find height and crop production are significant in (1), they may be working through their effects on health in middle life. We are not able to speak to that here. However, we are still able to test whether the *only* channels through which childhood affects health later in life is through socioeconomic status in middle age—that is, whether coefficients on childhood health (α_C) become insignificant when we control for education and occupation. In addition, we have limited information on the socioeconomic status of the households in which HRS cohort members were raised. To the extent that we find crop production is a significant predictor of health outcomes in old age, it may be that crop production affects household resources in childhood, and that household socioeconomic status is the channel through which early life circumstance affects health in old age. We discuss this later, and argue that the timing of crop production is consistent with mother's nutrition (although we certainly cannot rule out other channels).

The parameter estimates of (1) and (2) will be unbiased only under mean independence between the error term in (1) and e_y and C—that is, $E[\varepsilon_a | e_y, C] = 0$. There are situations under which conditional mean independence may not hold. There may be individual heterogeneity that is not measured by C—for example, individuals may have unobserved characteristics that result in both poor health and low socioeconomic status throughout life. Unfortunately, solutions to this problem either require a set of valid instruments for economic status and health at younger ages, or require fixed effect estimation, which in turn requires long panels of data. Neither approach is available to us here (even if we were not skeptical of the ability of instrumental variables to solve these problems, or skeptical of the assumption that coefficients are constant over the life course, which is necessary for the fixed effect analysis).

In the next section, we introduce the HRS data that we use in our analysis, and document the associations between adult height and later life health outcomes that we find in these data. We then turn to our econometric analysis and estimates of equations (1) and (2).

8.3 Height and Health in the HRS Cohort

Our analysis relies on the University of Michigan's longitudinal Health and Retirement Study (HRS), sponsored by the National Institute on Aging. Every two years, the HRS interviews a cohort of men and women in the United States over the age of fifty, in order to gain a better understanding of the physical and mental health, quality of life, and life circumstances of older Americans. (See http://hrsonline.isr.umich.edu for details.) Because some of the health indicators we are interested in were collected for the whole cohort only beginning in wave 3 of the study (1996), we will restrict our analysis to waves 3 to 7 (1996 to 2004). To reduce heterogeneity, we further restrict our analysis to non-Hispanic white men and women ages fifty and above in the HRS for whom no proxy respondent was used.

Summary statistics for this cohort are presented in table 8.1, where we report means of variables of interest for cohort members, in the first and last waves in which they are observed in our sample. Not all cohort members are observed in each wave from waves 3 to 7, and we do not restrict our sample to those who are. For table 8.1 only, the sample is restricted to individuals with nonzero sample weight in their first and last wave. Weighted and unweighted means are very similar, but throughout the analysis we will present results that have been sample weighted.

We examine six broad measures of health and functional limitations that are available in each wave of the HRS from waves 3 to 7. These measures are chosen because of their importance as markers of health, and because they are asked in a manner that makes them comparable across waves. All health measures are constructed such that a higher number can be interpreted as a worse health outcome. *Self-reported health status* is reported in each wave as 1 = excellent, 2 = very good, 3 = good, 4 = fair, 5 = poor. *Hypertension* is an indicator variable that the cohort members report that a doctor has

Table 8.1 Summary statistics for HRS cohort members

	Men		Women	
	First	Last	First	Last
Health outcomes and functional limitations				
Self-reported health status	2.57	2.80	2.60	2.85
Hypertension	0.38	0.51	0.38	0.53
Difficulties with activities of daily living	0.17	0.25	0.22	0.34
Large muscle group index	0.83	1.02	1.22	1.42
Fine motor skills	0.11	0.16	0.13	0.19
Gross motor skills	0.25	0.40	0.40	0.62
Childhood and early adult variables				
Height in inches	70.1	70.1	64.1	64.1
Corn production (billions of bushels)	0.38	0.37	0.36	0.36
Completed years of schooling	13.1	13.2	12.6	12.7
White-collar occupation in longest-held job	0.42	0.44	0.50	0.53
Geographic birthplace				
New England	0.07	0.07	0.07	0.07
Mid Atlantic	0.20	0.20	0.19	0.19
East North Central	0.23	0.23	0.22	0.22
West North Central	0.14	0.14	0.13	0.13
South Atlantic	0.12	0.12	0.13	0.13
East South Central	0.07	0.07	0.08	0.08
West South Central	0.08	0.08	0.09	0.09
Mountain	0.03	0.03	0.03	0.03
Pacific	0.06	0.06	0.06	0.06
Number of observations	6,090	6,090	7,439	7,439

Notes: Statistics are presented for the first and last observation (wave) in which the cohort member was observed. Sample is restricted to non-hispanic white men and women ages fifty and above, observed in waves 3, 4, 5, 6, and/or 7. All means are weighted using sample weights. For table 8.1 only, the sample is also restricted to individuals with nonzero sample weight in their first and last observation.

ever told them that they have high blood pressure or hypertension. Difficulties with *activities of daily living* (*ADLs*) are the sum of indicators for whether the cohort member reports difficulty bathing, eating, dressing, walking across a room, or getting out of bed. The *large muscle group* index is constructed as the sum of indicators of difficulty with four activities: sitting for two hours; getting up from a chair; stooping or kneeling or crouching; and pushing or pulling a large object. The *fine motor skills* index is constructed as the sum of indicators of difficulty picking up a dime, dressing, and eating, and the *gross motor skills* index as the sum of indicators of difficulty walking one block, walking across the room, climbing a flight of stairs, and bathing.

That members of the HRS cohort experience decline in these health indicators can be seen by comparing results between individuals' first reports and their last. The prevalence of hypertension, for example, increases from

40 to 50 percent over this period (generally 1996 to 2004) for both men and women. Women start, on average, from a worse health position on all dimensions. However, the declines experienced between the waves are quite similar for men and women.

Our first measure of childhood health and early life nutrition is adult height in inches, which is self-reported in the HRS. We present average heights of cohort members, by geographic region (division) of birth in figure 8.1. On average, men and women born in New England are almost an inch shorter than those born in the Pacific and Mountain states. The HRS cohort members born in later years are taller on average than those born in earlier years, as can be seen in nonparametric regression results presented in figure 8.2 for men and women born in New England and in the Pacific and Mountain states.

Our second measure of early-life nutrition is corn production in the cohort member's geographic birth place (division), in the year prior to his or her birth. These were drawn from the U.S. Department of Agriculture's National Agricultural Statistics Service. The HRS releases information on cohort members' geographic division of birth, and we have assigned to each

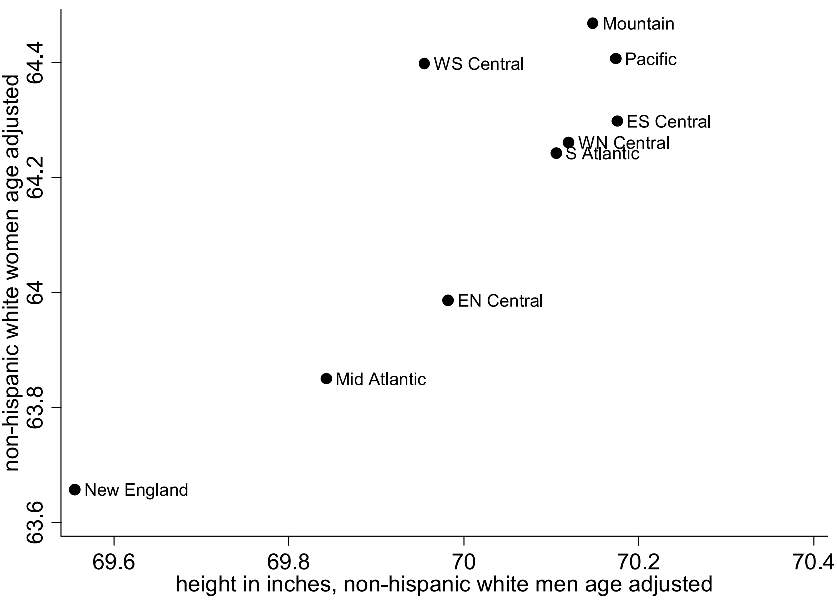

Fig. 8.1 Average heights in inches for women and men by geographic division

Notes: Non-hispanic white adult respondents in the HRS, age adjusted and weighted. States are grouped by division: New England: CT, ME, MA, NH, RI, VT; Mid Atlantic: NJ, NY, PA; East-North Central: IN, IL, MI, OH, WI; West-North Central: IA, KS, MN, MO, NE, ND, SD; South Atlantic: DE, DC, FL, GA, MD, NC, SC, VA, WV; East-South Central: AL, KY, MS, TN; West-South Central: AR, LA, OK, TX; Mountain: AZ, CO, ID, NM, MT, UT, NV, WY; Pacific: CA, OR, WA.

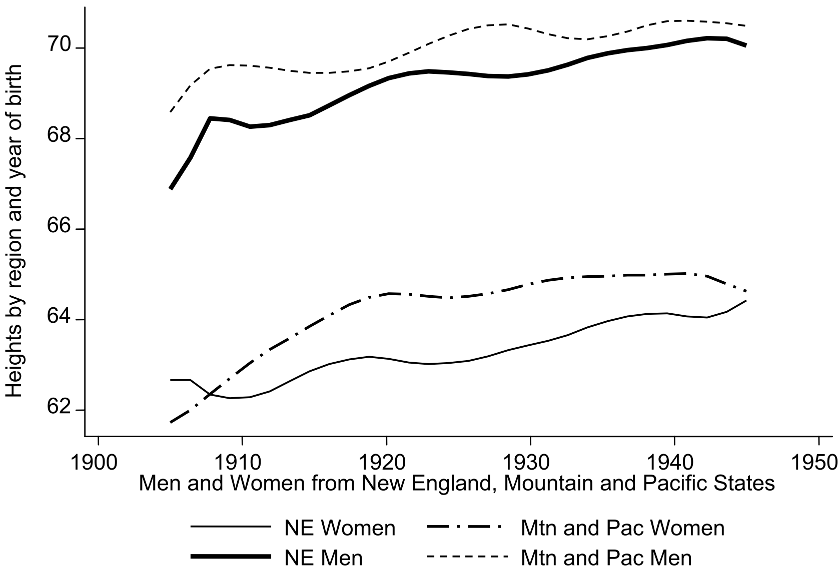

Fig. 8.2 Heights by year of birth

cohort member the corn production in his or her division in the year prior to his or her birth. We chose the year prior to birth, rather than birth year, because corn harvests generally take place in the mid- to late-fall, so that mothers who were pregnant with HRS cohort members in the fall and winter following the corn harvest would be most affected by the harvest prior to the birth year. We also have available wheat and oats production by year and division. Production is correlated between the three crops, and the pattern of results presented following is very similar to what we find when we use either wheat or oat production in place of corn. We do not argue that HRS cohort members' mothers were eating corn while pregnant, but that a good harvest would increase the probability of abundant nutritious foods for them to choose from.

Figure 8.3 presents harvests from the East North Central division, which includes three of the largest "corn belt" states (Ohio, Indiana, and Illinois). There is a great deal of variation from year to year in bushels harvested. The negative trend in production until approximately 1930 may be due to soil fertility depletion, and the upturn in production that followed may be attributable to the introduction of hybrid seeds and greater (and better) use of fertilizer (Bray and Watkins 1964; Crickman 1946). Corn production is sensitive to the amount of heat and rain a region receives during the growing season, and the low production in the early 1930s may also be attributable to years of severe drought (Crickman 1946). Production in the corn belt is an order of magnitude larger than that in many other divisions. In our regres-

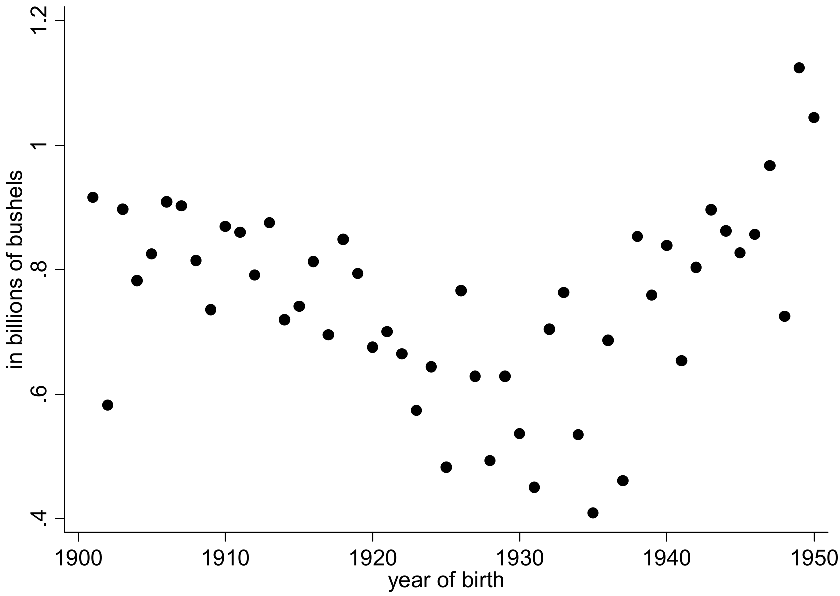

Fig. 8.3 Corn production in the East North Central Division by year

sion analysis, we will include a complete set of division indicator variables, so that the impact of corn production in any given year is relative to the mean for that division.

Our measures of socioeconomic status in young adulthood are years of completed schooling and an indicator that the longest held job was a white-collar job (here defined as professional, managerial, sales, clerical, or administrative support).

8.3.1 Health and Functional Status

Figure 8.4 presents a first look at the relationship between height, health, and functional status in the HRS cohort. Figures in the left-hand column present means of the prevalence of hypertension, ADLs, the gross motor skill index, the fine motor skill index, and the large muscle index, by five-year age categories from fifty to fifty-five to ninety-five to one hundred. There is physical decline between each age group, although the patterns vary: reports of hypertension increase markedly until age seventy-five and then level off, for example, while reports of difficulties with activities of daily living are relatively flat until age seventy, and then increase rapidly with age after that point.

Figures in the right-hand column are the coefficients on age category indicators interacted with height, from sample-weighted ordinary least squares (OLS) regressions that include a complete set of age-category indi-

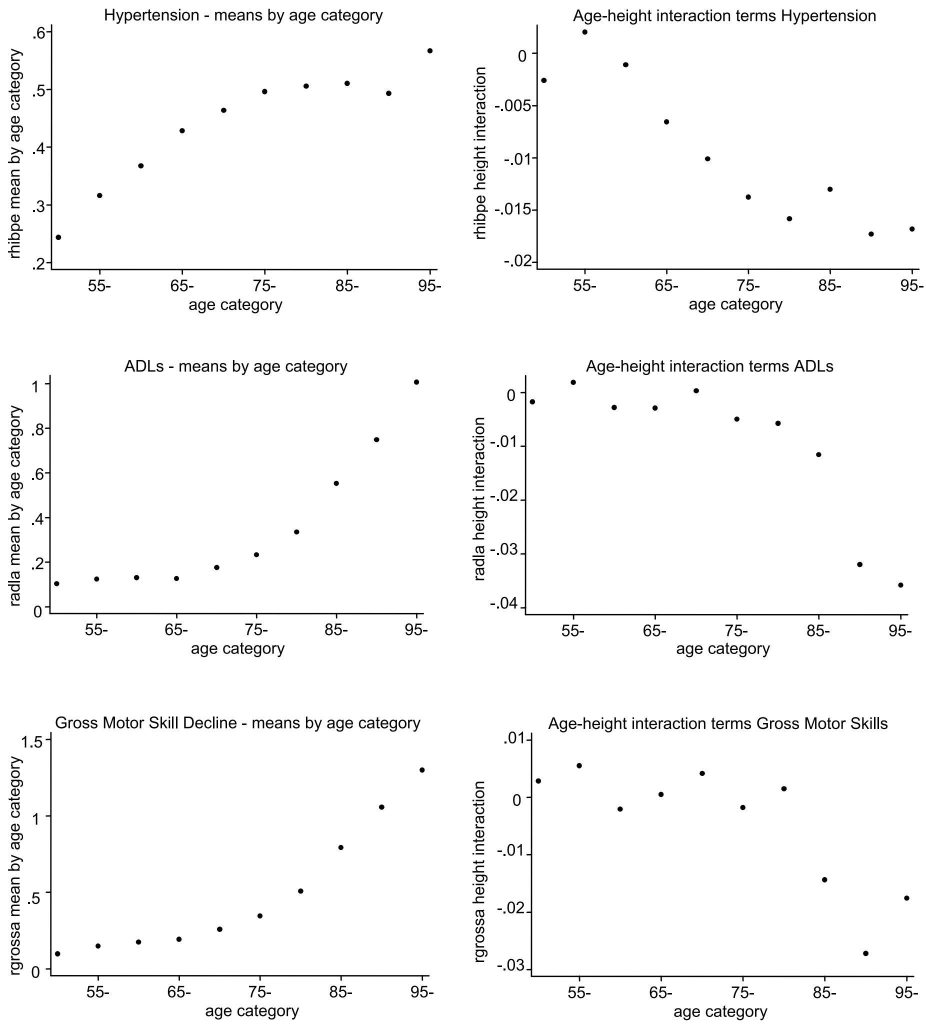

Fig. 8.4 Age-height interactions in functional limitations

cators, wave indicators, and a sex indicator. We find that height is protective against hypertension, ADLs, and loss of gross and fine motor skills. Height becomes protective when cohort members' risk of poor health outcomes becomes elevated. For example, the height-age indicator interaction terms become successively more negative from age category fifty-five to sixty to age category eighty to eighty-five. After that point risk of hypertension has leveled off, and the protection offered by height levels off as well. Similarly, with respect to ADLs, height offers no protection before the age at which

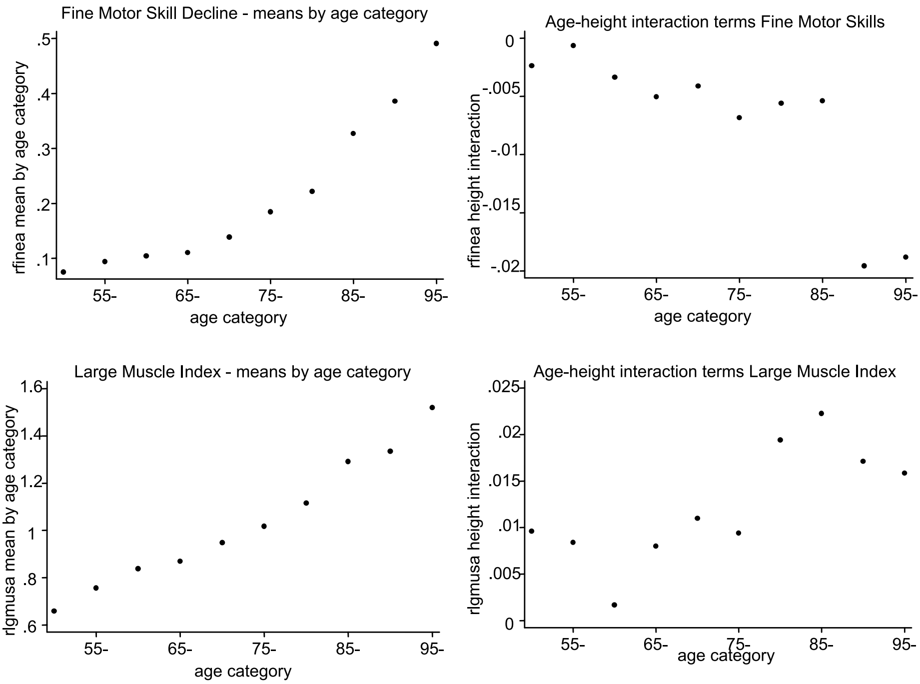

Fig. 8.4 (cont.)

individuals' risk of difficulties becomes nontrivial, after which point the height-age category interaction terms become negative and significant.

For all but one health measure, height appears to be protective, and more so at older ages. One category in which height is not protective is for the large muscle group index. Within this group of tasks, taller people report less difficulty pushing or pulling large objects, and no more or less difficulty than shorter people in sitting for two hours. However, they have significantly greater difficulty stooping, and getting out of a chair.

Figure 8.5 examines the extent to which height is protective of self-reported health status. In all age categories, taller people report better health (a lower number is a better score). The height-age interactions are significant for age categories from fifty to fifty-five through seventy-five to eighty. Beyond that point, there is no difference on average between taller and shorter adults in their self-assessed health. This may reflect selection in who lives past age eighty, a point we may return to in future research.

In summary, height predicts better health and fewer functional limitations in old age along a number of dimensions. We turn now to mechanisms through which height might protect health.

Fig. 8.5 Age-height interactions in self-reported health status

8.4 Health and Nutrition as Determinants of Education and Occupation

In this section, we examine the relationship between childhood conditions, as measured by height and corn production, and outcomes in adulthood. Table 8.2 presents OLS regression results for the HRS cohort, with one observation for each cohort member. We find a positive and significant association between corn production and adult height. On average, a one-standard deviation increase in corn production (.3895) is associated with a one-fifth of an inch increase in final adult height (.20 inches). This result is robust to estimating the height equation separately by division. For example, when estimated separately, we find that a one-standard deviation increase in corn production in East North Central leads to a (.14) inch increase in height there, (.20) in West North Central, (.36) in the Mountain division, and (.24) in the Pacific division, and that the differences between these estimates are not statistically significant.

Height is associated with increased years of education. The association between height and years of schooling is large, and robust to many changes in specification. When estimated separately by sex, results for both men and women show that a one inch increase in height is associated with a 0.10 to 0.12 increase in years of completed schooling, on average. The same is true when we run regressions separately by division (not reported in table 8.2). We find no significant relationship between corn production and years of completed schooling, with or without controls for height—so that although

Table 8.2 The relationship between early life circumstances, education, and occupation

	Dependent variable		
	Height in inches	Years of education	= 1 if longest-held job was in a white-collar occupation
Height in inches	—	.1168	.0093
		(.0085)	(.0015)
Corn production	.5053	–.0434	–.0808
	(.1867)	(.1860)	(.0332)
Female	–5.877	.3601	.1693
	(0.044)	(.0666)	(.0119)
Number of observations	13,775	13,775	13,775

Notes: Coefficients presented from OLS regressions (standard errors in parentheses). Observations weighted using sampling weights. Also included were a complete set of year of birth indicators by five year categories, and a complete set of division of birth indicator variables.

corn production predicts height, it cannot explain any of the association between height and educational attainment.

Height is also positively and significantly associated with respondents' reports that their longest held job was a white-collar job. This is again true for men and women when estimation is carried out by sex, and true when estimation is carried out division by division. Individuals born in years following a bumper corn year in their division are significantly less likely to report white-collar occupations. However, this result is not robust to estimating the white-collar regression separately by division. In no division is the association between corn production in the year before birth significantly associated with white-collar occupations later in life.

In summary, higher corn production in the year prior to birth is associated with greater adult height, and greater adult height is associated with both greater years of schooling and job holding in white-collar occupations. We turn next to estimate the extent to which these earlier life-course outcomes affect health in old age.

8.5 Health and Functional Limitation in Old Age

Table 8.3 presents OLS regression results for the health and functional limitation outcomes discussed before, where each health measure is regressed on height and corn production, with a complete set of indicator variables for cohort members' age, division of birth, sex, and survey wave. Given the results presented in figure 8.4, we allow the impact of height and corn to change with age. There are many possible ways to add flexibility to the impact of height and nutrition. Here, we add interaction terms of height

Table 8.3 **The impact of early life circumstance on health and functional limitations**

	Self-reported health		Hypertension	
Height in inches	–.0141	–.0008	–.0014	.0001
	(.0039)	(.0037)	(.0018)	(.0018)
Height × older	.0037	.0006	–.0115	–.0125
	(.0042)	(.0041)	(.0020)	(.0021)
Corn production (B bushels)	.0021	–.0050	–.0818	–.0815
	(.0694)	(.0681)	(.0345)	(.0346)
Corn production × older	–.0289	–.0203	–.0015	–.0002
	(.0431)	(.0419)	(.0219)	(.0219)
Years of education		–.1059		–.0135
		(.0047)		(.0023)
Education × older		.0305		.0089
		(.0065)		(.0033)
White-collar occupation		–.1930		–.0002
		(.0236)		(.0116)
White-collar × older		.1357		–.0045
		(.0363)		(.0184)
Number of observations	56,831	56,831	56,821	56,821
	Activities of daily living		**Fine motor skills**	
Height in inches	–.0007	.0025	–.0027	–.0009
	(.0025)	(.0025)	(.0014)	(.0014)
Height × older	–.0046	–.0044	–.0037	–.0037
	(.0026)	(.0026)	(.0016)	(.0016)
Corn production (B bushels)	–.0097	–.0148	.0121	.0087
	(.0382)	(.0380)	(.0226)	(.0227)
Corn production × older	–.0437	–.0437	–.0343	–.0346
	(.0270)	(.0270)	(.0165)	(.0165)
Years of education		–.0250		–.0137
		(.0031)		(.0018)
Education × older		–.0004		.0018
		(.0047)		(.0027)
White-collar occupation		–.0648		–.0324
		(.0134)		(.0076)
White-collar × older		.0217		–.0021
		(.0222)		(.0136)
Number of observations	56,829	56,829	56,829	56,829
	Gross motor skills		**Large muscle group index**	
Height in inches	.0020	.0080	.0062	.0170
	(.0032)	(.0032)	(.0044)	(.0043)
Height × older	–.0038	–.0042	.0055	.0013
	(.0035)	(.0034)	(.0046)	(.0046)
Corn production (B bushels)	–.0532	–.0604	–.1457	–.1510
	(.0517)	(.0513)	(.0776)	(.0777)
Corn production × older	–.0031	–.0020	.0350	.0447
	(.0360)	(.0359)	(.0482)	(.0479)

Table 8.3 (continued)

	Gross motor skills		Large muscle group index	
Years of education		–.0454		–.0870
		(.0041)		(.0056)
Education × older		.0052		.0499
		(.0061)		(.0074)
White-collar occupation		–.0979		–.1659
		(.0177)		(.0273)
White-collar × older		.0343		.0944
		(.0297)		(.0410)
Number of observations	56,830	56,830	56,821	56,821

Notes: OLS regression coefficients reported (with standard errors in parentheses). Observations weighted using sampling weights. Standard errors allow for correlation in the unobservables for observations for the same person. Included in all regressions are an indicator of sex, and a complete set of age indicator variables, indicators for the survey wave, and indicators for the cohort member's geographical division of birth.

and corn production with indicator variables that the cohort member's age is greater than seventy.

8.5.1 Self-Reported Health Status

The first set of results in table 8.3 report on self-reported health status. Taller cohort members report better health and, consistent with the results in figure 8.5, we find no change with age in the impact of height on self-reported health. Height is strongly predictive of education and occupation, and once we add controls for education and occupation, there is no longer a significant correlation between height and self-reported health. In regressions estimated (results not shown in table 8.3), we find it is the inclusion of a control for years of completed schooling that renders height insignificant. Adding indicators for white-collar occupation does not change the size or significance of the height variables. We interpret these results as being consistent with a model in which the effect of height on self-assessed health works through its effect on education.

On average, the impact of education and occupation on self-reported health is less pronounced for cohort members older than seventy. The interaction terms between education and an indicator for being older than seventy, and the interaction term between white-collar occupation and age above seventy, are both positive and significant. Neither interaction term entirely offsets the protective effects of greater education or having worked in a white-collar job, but their effects are dampened at oldest ages.

8.5.2 Hypertension

Both height and corn production are negatively and significantly related to the probability of reporting hypertension. The effect for height appears at older ages (above age seventy), and is robust to the inclusion of controls for educational attainment and occupation. In contrast, the effect for corn production is equally strong at younger and older ages, and is also robust to the inclusion of other controls.

Education is significantly correlated with hypertension, although like height, its association is weaker above age seventy. Having worked in a white-collar occupation is not associated with hypertension, given controls for age, division of birth, and sex. Using a set of occupational categories (estimated but not reported in table 8.3) we also find that occupation does not change the large and significant relationship between height, corn production, and hypertension. This is inconsistent with hypotheses generated from pathway models that suggest early-life environment only matters through its impact on early adult outcomes (such as occupational choice).

8.5.3 Activities of Daily Living and Fine Motor Skills

Height and nutrition are protective against decline in both ADLs and fine motor skills above age seventy. The ADL index increases on average by 0.01 with each year of age, the fine motor skill index by 0.006. Using this metric, an extra inch of height translates into a rolling-back of the age clock by approximately half a year. The impact of height and nutrition on these health measures are unchanged by the inclusion of education and occupation variables, which themselves have large, significant effects on both indexes at all ages. These results suggest that, whatever the mechanisms are that lead height and corn production to affect ADLs and fine motor skills at older ages, they are not working through education or occupational choice.

8.5.4 Gross Motor Skills and Large Muscle Group Indexes

Neither height nor corn production are significantly associated with the gross motor skill index, while education and white-collar occupations are protective for both older and younger HRS cohort members.

Consistent with figure 8.4, we find height increases the large muscle group index. Taken together, the coefficients on height and height interacted with being an older cohort member are jointly significant (p-value = 0.03) in the second to the last column of table 8.3. We find (results not shown) that this is due to taller cohort members reporting more difficulty crouching or stooping, and more difficulty getting out of a chair. In contrast, corn production is negatively and significantly associated with the large muscle group index, and has its largest effect on reporting being able to push or pull a large object. We find education and white-collar occupation protective for all cohort members, but less so at older ages.

8.6 Discussion

Results presented here are consistent with early life environment having lifelong effects on health. Here, we conclude with three thoughts.

We interpreted corn production in the year prior to birth to be a marker for mothers' nutrition while pregnant. There are other, quite different, interpretations. Crop production in the fall prior to birth, for example, may be a marker for higher socioeconomic status around the time of the child's birth, which may have independent effects on children's outcomes. (Perhaps the house was better heated, for example, or there was money to see a doctor when needed.) However, the timing of the impact of crop production is consistent with the effect working through maternal nutrition. When cohort members are assigned the crop production in the year of their birth (rather than the year prior to birth), we find no effect of corn production on reports of hypertension, and no effect on ADLs. If, as has been argued by Barker (2004), hypertension is especially sensitive to nutrition in utero, then the sensitivity of hypertension to crop production in the year prior to birth may point to crop production being a marker for nutrition.

At oldest ages, it is important to recognize the role that selective mortality may play in the estimation. Less well educated people who survive to age eighty-five may be a more select group than better educated people who survive to that age, for example. Finally, the crop production data by state and year of birth can be matched to several data sets that contain information on state of birth and current (adult) health. It will be useful analyze additional data—both as a cross-check for results here and to investigate additional channels through which early life environment affects adults in older age.

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Comment James P. Smith

In the last decade, economists have rediscovered health as a fundamental subject of research (Smith 1999). The subsequent research has been instructive and insightful. Not the least among these important contributions has involved documenting the importance of childhood health, not only on subsequent health outcomes during the adult years, but also, and in large part due to this life-course health linkage, on a series of economic outcomes as an adult. These outcomes have included final years of schooling, labor supply, income, and occupational status (Smith 2006). Anne Case with her colleagues has been among the most important contributors in this fast expanding literature with a series of papers documenting these linkages into the early and middle part of the adult years (see (Case, Lubotsky, and Paxson 2002) and (Case, Fertig, and Paxson 2005) for two examples). This chapter extends Anne Case's excellent recent work with Chris Paxson on height and childhood health into much older ages than she has done before by using the Health and Retirement Survey (HRS), which samples a population of Americans who are at least fifty years old (Case and Paxson 2006).

The central thesis of Case and Paxson is that very early childhood health is extremely important for subsequent adult health and SES outcomes. Measuring childhood health is difficult in itself, but combining it with data that measure these outcomes during the adult years is extremely challenging. The key insight of Case and Paxson is that adult height is a particularly

James P. Smith holds the Rand Chair in Labor Market and Demographic Studies at the RAND Corporation.

These comments were written with the support of grants from the National Institute on Aging and were delivered at a NBER conference on the Economics of Aging, Carefree, Arizona, May 2007.