MARITAL PROTECTION AND MARITAL SELECTION: EVIDENCE FROM A HISTORICAL-PROSPECTIVE SAMPLE OF AMERICAN MEN*

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Whether marriage causes people to live longer or whether healthier people select into marriage is an open question. In this study I followed a sample of men from age 18 to first marriage and ultimately to death. Health in early adulthood was represented by height and weight around age 20. The probability of ever marrying and the conditional probability of marriage in a given time period were lower for smaller men and greater for larger men. Marriage significantly lowered mortality risk even after controlling for health in early adulthood. Thus I found support both for selection into marriage and for protective effects of marriage.

The relationship between marital status and mortality is a classic example of the difficulty in determining causality in the social sciences. Longevity is greater among married men and women than among the never-married, divorced, or widowed; this is one of the most robust results in demography (Hu and Goldman 1990). Being married may cause spouses to live longer than if they were not married, a phenomenon known as the *protective* effect of marriage. A spouse provides comfort during stress, care in illness, and companionship throughout life, and encouragement to act so as to reduce mortality risk: for example, by moderating alcohol consumption (Waite 1995). At the same time, healthier people (who could be expected to live longer) enjoy better marital prospects; this suggests a possible source of *selection* bias into marriage. The healthier the prospective spouse, according to this view, the better a spouse he or she would make in terms of reducing the likelihood of being widowed. Thus the good health that may lead to a long life also makes marriage more likely.[1]

Empirical study of the marriage-longevity phenomenon has been limited by the tendency of most marriages to occur long before the spouses' deaths. A researcher undertaking a longitudinal study would face enormous difficulties in tracking couples over the decades necessary to observe sufficient numbers of deaths. As a result, longitudinal studies of present-day mortality necessarily use risk periods as short as six years (Lillard and Panis 1996). An alternative is to substitute measures of morbidity for mortality and to consider the relation between marital status and illness (Waldron, Hughes, and Brooks 1996). Another fallback strategy is to estimate age-specific death rates by marital status, using cross-sectional data. This technique generally yields higher death rates for the unmarried, but Goldman (1993) has demonstrated that it can lead to spurious inferences. She concluded (p. 204) that "longitudinal data may offer the only promising approach" to distinguishing between selection and protective effects of marriage.

In the present study I test for selection into marriage and for protective benefits of marriage using a sample that is both historical and prospective. According to Goldman (1993: 191), "[t]he ideal data set for this purpose"—that is, the study of marriage-mortality relationships—"would be a prospective survey which follows a young unmarried sample through the adult life span, collecting repeated measures of marital status." The present sample consists of 1,961 male graduates of Amherst College in Massachusetts, who were followed from matriculation to death. Born between 1832 and 1879, all of these men were unmarried when they entered the sample at age 18. Amherst's alumni office collected information on the date of first marriage, occupational information, and date of death, among other variables (Amherst College 1963); therefore this sample is close to ideal for examining potential relationships between nuptiality and mortality.

A distinctive feature of this sample is its inclusion of a measure of health status in young adulthood, namely body size. Each man's height and weight were measured by Dr. Edward Hitchcock, one of the best-known anthropometrists of his day. I linked each anthropometric record to published biographical information, so that each subject could be followed from graduation to marriage (except for lifelong bachelors) and then to death. Thus, protective effects of marriage can be examined with controls for selection bias (by health status) into marriage in early adulthood. Dates of wives' deaths and data on subjects' subsequent marriages were not consistently available, so in this study I examine only the time to first marriage and whether the subjects ever married.[2]

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1. William Farr observed the converse in 1858: "Several hereditary diseases present practically some bar to matrimony" (quoted in Goldman (1993:190).

2. Similarly, although earlier research with these data (Murray 1997) included both nongraduates and graduates of the College, marriage and occupational information on the nongraduates was reported so unevenly that I included only graduates in the present study.

The period during which the subjects were at risk of death could be extended in nearly all cases to the end of the subject's life. Few observations were censored; therefore the likelihood of uncovering a relationship between health status in young adulthood, timing of marriage, and risk of death much later in life was greater than in studies with short observation periods. In fact, the Amherst data indicated selection into marriage by health status in early adulthood, as reflected both by height and by weight adjusted for height. According to both of these anthropometric measures, smaller men faced a lower probability of ever marrying and a lower conditional probability of marrying soon, given bachelorhood to the previous time period. The probability of marriage actually was higher for somewhat overweight men; for obese men, it was the same as for those of average weight. The tallest men were most likely to marry and to marry sooner.

Marriage improved survival prospects even after controlling for health status in early adulthood. Whether marriage was defined as ever having married or as the conditional probability of marriage in a given time period, it significantly reduced mortality risk. Only the largest weight-for-height category, obesity, increased mortality risk significantly, and it did so without regard to marital status. This sample, then, contained evidence of both selection into marriage by health and protection from mortality by marital status; the two forces operated simultaneously.

DEMOGRAPHIC AND ANTHROPOMETRIC HISTORY

"Health status" is a multidimensional category, which would seem to reduce to a single statistic or two only with great difficulty. Work by medical scientists, physiologists, and anthropologists, however, suggests that average measures of height and weight taken from large samples can represent health and nutritional well-being with reasonable accuracy. Final adult height is a net measure of nutritional status in the following sense. Beginning with the quantity of gross nutrition in terms of calories and protein, growth results from the residual of this nutritional intake minus the demands of work intensity, disease fighting, and maintenance during the growing years. Average final height thus reflects the group's *net nutritional status* as it results from environmental influences on individual group members during their years of growth. In the words of a pioneering scholar in the field, "The study of growth emerges also as a powerful tool for monitoring the health and nutrition of populations.…The study of growth has a very direct bearing upon human welfare" (Tanner 1978:219).

Average height and weight data are used commonly to represent a group's net nutritional status (Steckel 1995). In the present research I employed anthropometric data primarily at the individual level, where adult heights are heavily influenced by parental heights. Although it remains reasonable to interpret body size as reflecting the subjects' net nutritional status, genetic influences at the individual level, which would wash out in aggregated data, increase standard errors in the statistical analysis. Individual-level observations may also be confounded by cultural standards of male beauty (e.g., "*tall*, dark, and handsome"), which bestow social and economic benefits on those seen as beautiful (Averett and Korenman 1996). Evidence that height and weight influence nuptiality and mortality at the individual level, even if subject to a wider range of interpretations than in studies with aggregated data, suggests the value of recognizing anthropometric influences on well-known demographic trends.

Height can be measured relatively easily. The measurement of weight, however, did not become widespread until after the mid-nineteenth century, when relatively cheap scales began to be mass produced. Thus, large samples of weights probably do not exist from eras before the Amherst sample. Weights by themselves are not very useful because they must be adjusted for the subject's height. Several statistics exist for this purpose. Body mass index (BMI, which equals weight in kilograms divided by height in meters squared) is the most commonly used of such measures. Because BMI is the measure of bulk that is correlated least with height, it yields the most independent assessment of net nutritional status among the several weight-related measures. Whereas height is the result of net nutrition during the subject's growing years, BMI measures net nutritional status in the months before measuring, although childhood factors also may play a role (Eveleth and Tanner 1990).

Heights of past populations have been examined in the belief that they resulted from economic and disease conditions experienced by sample members (Steckel 1995). These studies model human growth processes as a function of conventional measures of living standards, such as real wages or per capita national income. Several studies (e.g., Steckel and Floud 1997) have found close relationships between economic variables and average adult height in the United States, France, the Netherlands, Japan, and elsewhere. Generally the researchers suggest that patterns in average heights followed from variation in national per capita income, real wages, or other, similar measures of economic well-being.

Anthropometric measures also can be viewed as causes, not solely as effects, in some economic and demographic processes. In the past, for example, and in developing and developed countries today, body size and productivity have been associated positively. Margo and Steckel (1982) showed that taller slaves sold for higher prices, presumably because their height indicated that they were capable of greater productivity. Strauss and Thomas (1998) described at length relationships between height, productivity, and wages in developing countries. Averett and Korenman (1996) associated men's underweight status with lower wages. Using a subsample of married men in the present data set, Murray and Lagger (forthcoming) estimated a nonlinear relationship between BMI and the probability of ever fathering a child: Men of average size were more likely to father children than were larger or smaller men. Later in life, Costa (1996) found, men's retirement decisions were related closely to their health status as expressed by BMI: Men of roughly average size were less likely to retire than larger or smaller men.

Other studies have found that body size may influence marital prospects. In two historical studies, greater height conferred marital advantages on both men (Whaples 1995) and women (Baten and Murray 1998). The relationship of height to nuptiality may have been a result of cultural standards associating height with beauty, or height may have served as a signal of greater earning capacity, or it may have been viewed as a sign of health status. Averett and Korenman (1996) found an intriguing pair of relationships in their sample of men: Except for the obese, BMI and income relative to needs were related positively, as were BMI and marital prospects. These researchers inferred that relationships between body size and nuptiality may be mediated by the wife's expectations of family income based on the husband's body size. Existence of such a relationship between height and nuptiality can be tested with the Amherst sample.

The relationship between body size and mortality risk is somewhat more complex (Elo and Preston 1992). Early historical studies that estimated average adult height from large samples suggested that height and longevity were related positively and in nearly linear fashion (Fogel 1986). Inspired by Waaler's (1984) work with present-day individual-level samples, historical demographers replicated his findings that both height and BMI had a nonlinear, U-shaped relation to mortality risk, with average-sized persons at lower risk (Costa 1993). Further research has corroborated such a nonlinear relationship between BMI and mortality risk; this work has even found, in both historical and present-day studies, similar ranges of BMI that minimized mortality risk (Murray 1997).

The relationship between mortality risk and height seems less robust than between mortality risk and BMI. If there is a relationship between height and mortality risk, it is probably not directly causal but exists through their joint dependence on other influences, particularly cardiovascular disease (Elo and Preston 1992). Some historical demographers hold that height-mortality relationships in historical samples are spurious (Johansson 1994). In one study (Riley 1994) that lacked mortality information for its sample members, the investigator nevertheless hypothesized that height and mortality were unrelated. Using the present sample, I could not detect a relationship between height and mortality risk (Murray 1997).

A mediating role for nuptiality in the past has not yet been examined. In the present study I consider the effects of both body size and marriage on mortality risk. Holding constant health status at age 20 or so should help to isolate any protective effects of marriage; controlling for marital status may clarify the effect of health in early adulthood on mortality in later life.

Although the men in the Amherst sample were not typical of Americans of their day, many similarities can be found between these men and other samples. Table 1 presents mean values and standard deviations of some descriptive variables. At 173.2 cm, the average height of the Amherst men was about 2 cm less than that of Citadel students of the same birth cohorts (Komlos and Coclanis 1995). The Amherst men were between 1 and 2 cm taller than contemporary West Point cadets (Komlos 1987) and a larger sample of American soldiers (Costa and Steckel 1997). One of the most surprising findings in anthropometric history is the consistent decline in stature among birth cohorts through the mid-nineteenth century (Komlos 1996). This trend occurred among the Amherst students as well: Height declined by 1.3 cm from the birth cohorts of the 1830s to those of the 1850s. On average, the Amherst students' BMI was larger than that of the West Point cadets (Cuff 1993).

Nuptiality among nineteenth-century Americans is best understood indirectly (Haines 1996; Monahan 1951). By the

TABLE 1. CHARACTERISTICS OF AMHERST SAMPLE

Variable	Full Sample	Sample With Known First Wedding Date
Age at First Marriage (of Those Ever Married)	NA	31.19 (6.68)
Lifelong Bachelors	0.13	0.14
Age at Death	67.87 (16.29)	67.84 (16.26)
Body Mass Index	21.29 (2.03)	21.28 (2.02)
Underweight: BMI ≤ 20	0.26	0.26
Recommended: 20 ≤ BMI < 24	0.66	0.66
Overweight: 24 ≤ BMI< 29	0.08	0.08
Obese: 29 ≤ BMI	0.004	0.003
Height (cm)	173.2 (5.99)	173.2 (5.99)
Very short: height ≤ 161	0.02	0.02
Short: 161 ≤ height ≤ 167	0.12	0.12
Medium: 167 ≤ height ≤ 179	0.69	0.69
Tall: 179 ≤ height ≤ 185	0.14	0.14
Very tall: 185 ≤ height	0.03	0.03
Occupation		
Business	0.22	0.22
Teacher	0.20	0.20
Lawyer	0.18	0.18
Physician	0.11	0.11
Minister	0.20	0.20
Other	0.10	0.10
Birth Cohort		
1830–1839	0.06	0.06
1840–1849	0.18	0.18
1850–1859	0.17	0.17
1860–1869	0.32	0.32
1870–1879	0.27	0.27
N	1,961	1,937

Notes: Proportion or mean value is given, with standard deviation of continuous variables in parentheses.

end of the colonial period, marriage apparently was early and nearly universal, in contrast to the western European pattern of later marriage and a substantial minority of never-married adults. Around the turn of the twentieth century, census and other federal surveys indicated that age at first marriage was rising, as was the share of adults who never married. Marriage must have become less common at some point in the nineteenth century, then, and it occurred at later ages. Because much of the available data on nineteenth-century nuptiality pertains to women, as a natural extension of interest in fertility trends, the nuptial behavior of the nineteenth-century men in the Amherst data is worth examining.

Nuptiality among the Amherst men was roughly similar to that elsewhere in America. Figures 1 and 2 respectively show trends in the share of men who were lifelong bachelors among the Amherst men and in the 45–54 age group in census data (Haines 1996). The men are arranged by birth cohort to facilitate comparison. The share of bachelors increased until mid-century in both groups. This increase continued in the national sample: The Amherst group contained more lifelong bachelors, on average 13% in the entire sample, whereas the national share was under 10% in most cohorts.

Age at first marriage among the Amherst students was similar to that among members of later nineteenth-century classes at Harvard, Yale, and Syracuse (Monahan 1951:106). For the Amherst students, median age at first marriage increased from 29.75 in the 1830s birth cohort to 30.89 in the 1870s cohort. Median age at first marriage is available for few contemporary populations (Monahan 1951:72–73); for men in Pennsylvania in 1913, upper New York State in 1920, and New Jersey in 1889, it fell into a narrow range of 24 to 25 years. Thus the Amherst students married later than most men, but that tendency apparently was typical of college graduates of the day.

Mortality among the Amherst men differed from that in the general population of men. Several estimates of life expectancy at age 20 (Haines 1998) suggest a range of 38 to 42 years during the later nineteenth century. This also was the range of e_{20} found for eighteenth-century Yale graduates (Hacker 1997). The comparable figure for the Amherst students was about 10 years longer (Murray 1997), an indica-

FIGURE 1. STATURE AND NUPTIALITY, AMHERST MEN

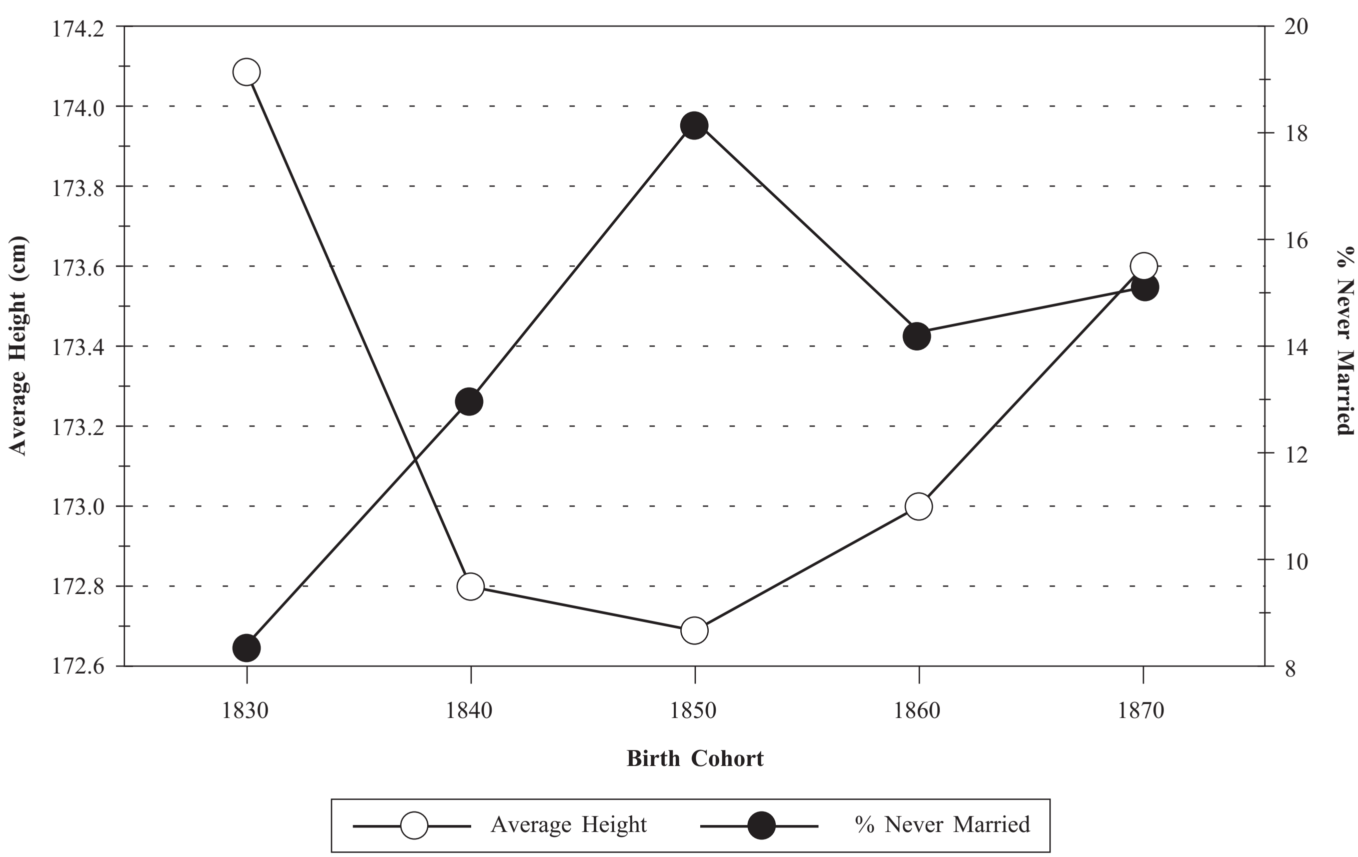
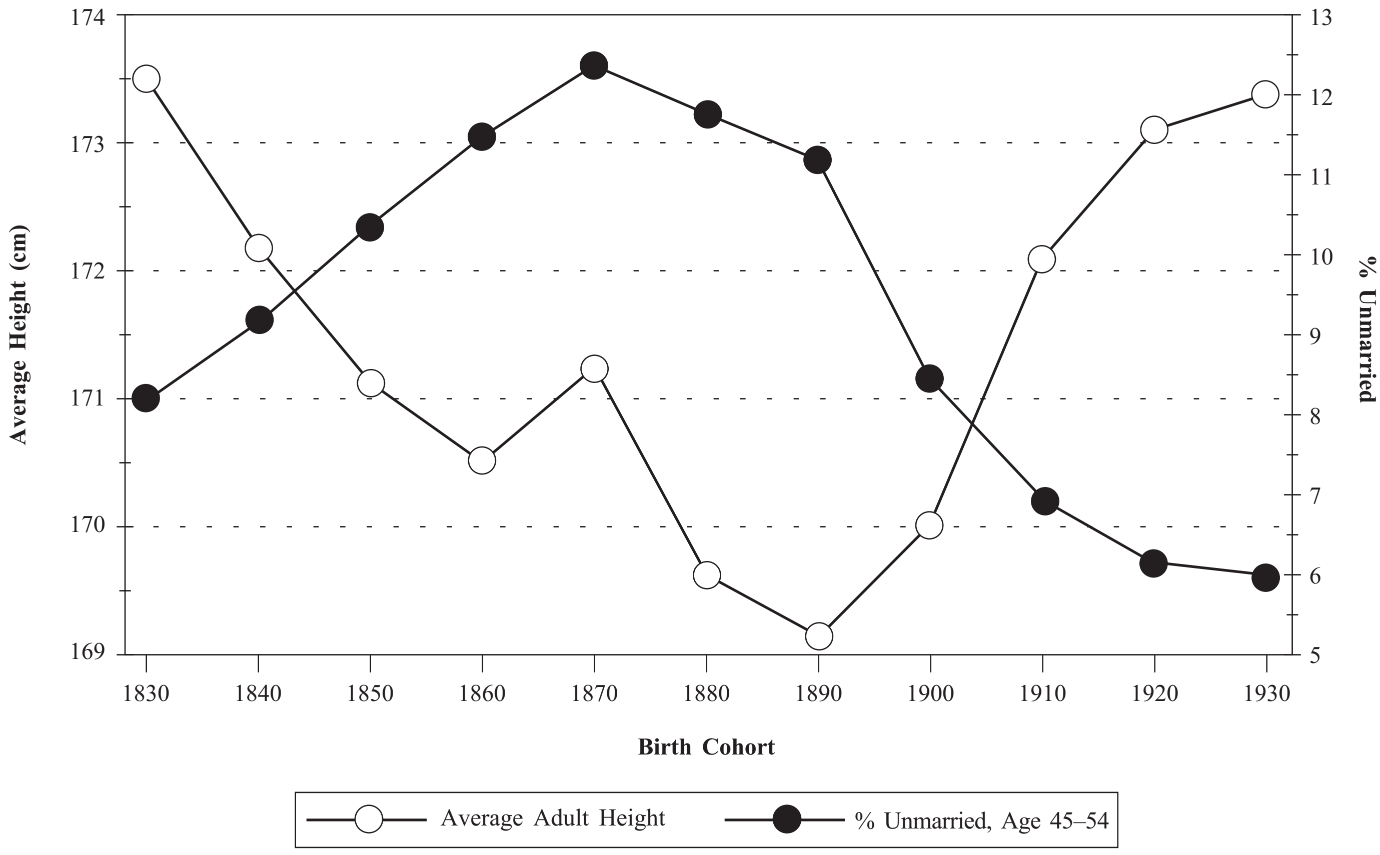


FIGURE 2. STATURE AND NUPTIALITY, AMERICAN MEN



tion that the Amherst students enjoyed longer lives than the average American men of their day.

SOURCE OF DATA

As mentioned earlier, the Amherst height and weight figures were recorded by Edward Hitchcock, one of the leading anthropometrists of the nineteenth century. The first professor of physical education at an American college, Hitchcock created anthropometric records that a contemporary researcher, Jay Webber Seaver (1896:93), called "the most complete in existence in this country." The quality of the measurements was unusually high, according to contemporary experts. Francis Galton, who coined the word *eugenics* and "transformed the study of growth" in Britain by introducing more precise measuring techniques (Tanner 1981:185), judged that Hitchcock's work was "carefully made by the same methods and instruments" each year, and urged that Hitchcock publish more of his results (Galton 1889:192).

Hitchcock measured each Amherst College student's height and weight at least once, and measured many several times. We can assume that the students were measured without shoes and weighed without clothes; these were the recommendations of the American Association for the Advancement of Physical Education, as made by a committee on which Hitchcock served while he was president of that organization (Hitchcock 1887). Anthropometric data from the Amherst classes of 1861–1864, 1866–1869, 1871–1876, and 1879 can be found in the published college annuals.

Data from the classes of 1884–1899 were recorded in bound manuscript volumes that are now kept in the Amherst College Archives. Anthropometric data for the remaining classes (1865, 1870, 1877, 1878, and 1880–1883) have been lost. The figures in the manuscript volume were recorded in meters to the third decimal place; weights were recorded in kilograms to one decimal place. Thus data heaping, in which fractional results are rounded off unpredictably and the data cluster near round figures such as whole inches or feet, was not an issue. Precise dates of birth, marriage, and death prevented age-heaping problems.

Right-censoring of lifetimes was quite limited. Amherst College (1963) published a short biography of every Amherst student in the *Amherst College Biographical Record*. These entries described each man's further education, career, wedding date, wife's name, number of children, and date and place of death. At the time of publication, some men of the later nineteenth-century classes were still alive. These men were coded as censored at the publication date of 1963 in the mortality analysis. A few others were lost to the Alumni Office and were coded as censored as of the last year in which they had reported their activities to Amherst. Linkage of the anthropometric record to the nuptiality and mortality record is valuable; it could be performed with similar records from other colleges to reveal whether the present conclusions can be replicated.

Age at measurement was known to the day for most of the sample, but had to be estimated for classes before 1884. For the later classes, age at measurement could be determined precisely as the difference between date of measurement recorded by Hitchcock in the manuscript volumes and the birth date as given in the *Biographical Record*. In the earlier classes, for which height and weight were taken from yearbooks, no date of measurement was given. Hitchcock (1879) wrote that he had measured students each year in the 1860s and 1870s, and the manuscript volume indicated that measurements were taken every spring in the 1880s and 1890s. Thus I estimated the measuring date as shortly before the student left the College.

The socioeconomic composition of this sample apparently did not change over the period of collection. In his history of the College, Claude Fuess (1935:191, 243) described classes at the beginning and the end of the sample period in similar terms: "homogeneous" and "uniform," with a small proportion of "poor boys" who had to work their way through school. The majority of students "came from substantial middle-class families, and were the sons of farmers and professional men."[3] Between a decline in the number of future ministers, who were not charged tuition, and an increase in students on scholarship, the proportion of students receiving some kind of tuition assistance remained constant (Tyler 1895). In short, the cohorts in this sample had access to roughly similar, and high, levels of economic resources during their growing years up to the time of their measurement. The homogeneity of the sample can be regarded as an asset because it eliminates the need to control for various socioeconomic characteristics in the multivariate analysis presented below.

SELECTION INTO MARRIAGE BY NET NUTRITIONAL STATUS

If anthropometric measures capture a sample's health and nutritional status, and if health may have been a determinant of marriage probabilities, then it is potentially fruitful to study nuptiality as a function of body size. Figures 1 and 2 suggest that height influenced marital prospects among American men in general and Amherst men in particular. Figure 1 displays the average height of the Amherst men by birth cohort and the proportion who never married. For comparison, Figure 2 shows similar information on the nation as a whole: The men's average height is compared with the percentage of older men who never married (Costa and Steckel 1997; Haines 1996).[4] The similarities between the two figures are striking: Both among the Amherst men and nationally, stature and bachelorhood were related negatively (estimated correlation coefficients for Amherst: $r = -0.74$, $p = 0.15$; for national sample: $r = -0.74$, $p = 0.006$).

The Amherst data set offers two ways to define marital status. First, some men never married and spent their lives as bachelors; thus one measure is a dummy variable set equal to 1 for the ever-married and 0 for the never-married. A second, more precise measure might recognize that some of these men married soon after college, some later in life, and some not at all. Health in early adulthood could have been a factor in determining how soon, as well as whether, they married. Duration models are designed to answer such questions.

In duration analysis the dependent variable is generally the time from entrance into a sample to an event such as marriage, death, divorce, or finding a job. The dependent variable is right-censored if the event has not yet occurred when the at-risk period ends, or if the researcher loses track of the subject. Motivations for use of hazard models include their ability to accept right-censored durations, which occur here in the case of lifelong bachelors (in the nuptiality regressions) and those men who were still alive when the *Biographical Record* was published (in the mortality regressions), and their ability to accept time-varying independent variables, such as student status (in the nuptiality regressions) and marital status (in the mortality regressions). Both for time to first marriage and for time to death, I employed the Cox proportional hazard model (Allison 1995) in this study.

Table 1 describes the categories for each measure of body size. BMI categories were defined as underweight for men with BMI under 20, recommended weight for BMI between 20 and 24, overweight for BMI between 24 and 29, and obese for BMI over 29. The categories match those used in Fu and Goldman (1996) and Averett and Korenman (1996), who in turn derived them from previously published studies of BMI and mortality risk. Those researchers' intention, and mine, was to facilitate comparisons between different samples.

Height categories were determined by numbers of standard deviations from the mean. The omitted category of medium height is the mean height in the sample plus and minus one standard deviation; "short" and "tall" are one to two standard deviations from the mean; and "very short" and "very tall" are more than two standard deviations from the mean.

Table 2 shows the results of three regressions of marital status on body size, occupation, and birth cohort. Model 1 is a logit regression in which the dependent variable was set equal to 1 if the man had ever married and to 0 for lifelong bachelors. Models 2 and 3 are proportional hazard regressions in which the duration is the time from the man's eigh-

3. Galton (1889:192) also referred to the Hitchcock sample as "homogeneous."

4. Compare the similar pattern between height and longevity among nineteenth-century American men in Fogel (1986).

TABLE 2. REGRESSION MODELS OF NUPTIALITY

	Model 1		Model 2		Model 3	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Intercept	3.39**	0.29	NA		NA	
Student Status					–3.01**	0.37
Body Mass Index						
Underweight	–0.38*	0.15	–0.17**	0.06	–0.13*	0.06
Recommended	Omitted		Omitted		Omitted	
Overweight	0.70*	0.32	0.16†	0.09	0.15†	0.09
Obese	–0.10	1.08	–0.48	0.45	–0.59	0.45
Height						
Very short	–1.04**	0.39	–0.50*	0.20	–0.59**	0.20
Short	–0.34†	0.20	–0.08	0.08	–0.07	0.07
Medium	Omitted		Omitted		Omitted	
Tall	–0.44*	0.19	–0.18*	0.07	–0.15*	0.07
Very tall	1.43†	0.73	0.43**	0.14	0.34*	0.14
Occupation						
Business	–1.15**	0.29	–0.24**	0.08	–0.26**	0.08
Teacher	–1.32**	0.28	–0.32**	0.08	–0.32**	0.08
Lawyer	–1.59**	0.28	–0.50**	0.08	–0.61**	0.08
Physician	–1.15**	0.32	–0.40**	0.09	–0.50**	0.09
Minister	Omitted		Omitted		Omitted	
Other	–1.87**	0.30	–0.60**	0.10	–0.56**	0.10
Birth Cohort						
1830–1839	0.09	0.38	0.06	0.11	0.30**	0.11
1840–1849	–0.25	0.21	0.03	0.08	0.17*	0.08
1850–1859	–0.40*	0.20	–0.02	0.08	–0.02	0.08
1860–1869	–0.04	0.18	0.003	0.06	0.06	0.06
1870–1879	Omitted		Omitted		Omitted	
–2 Log-Likelihood	1,451		22,959		22,566	
N	1,961		1,937		1,937	

Notes: Model 1 is a logit regression with dependent variable set equal to 1 if ever married. Model 2 is a proportional hazard regression with dependent variable equal to the time from age 18 until first marriage or death; lifelong bachelors were coded as right-censored at death. Model 3 is similar to Model 2 but has a time-varying regressor, student status, for time as a student at Amherst. Difference in sample sizes is due to availability of date of marriage; for 24 men the date was unknown, but the *Amherst College Biographical Record* reported that they had married at some time in their lives.

†$p < .10$; *$p < .05$; **$p < .01$

teenth birthday to his (first) wedding date. Model 3 differs from Model 2 by the inclusion of a time-varying regressor reflecting student status at Amherst. I chose age 18 as the beginning of the duration because the first man in the sample to marry was just past his eighteenth birthday; this suggested that empirically these men became "at risk" of marrying around age 18. For lifelong bachelors, the period in which they were at risk of marrying ended with their deaths; thus I coded these durations as right-censored. The coefficients in Models 2 and 3 show the effect of a change in the independent variable on the hazard of marrying: that is, the conditional probability of marrying in a particular year, given bachelorhood up to that year. The logit and the hazard models differ in sample size: Twenty-four men were known to have married, and thus could be used in the logit regression; their wedding dates, however, were unknown, so they could not be included in the proportional hazard regressions.

The regressions show significant relationships between marital probabilities and both height and BMI. Underweight men were significantly less likely ever to marry (Model 1) and were significantly less likely to marry in a particular year, given bachelorhood up to the previous year (Models 2 and 3). Overweight men were significantly more likely ever to marry and had a higher conditional probability of marrying in the coming year. For the very few men who were obese, marital prospects were similar to those of recommended weight. The effect of height was concentrated in the two extreme categories: Very short men's nuptial prospects were reduced significantly, and the very tall enjoyed greater probabilities of marrying. These patterns persisted in Model 3, in which enrollment at Amherst was modeled by a time-varying regressor set equal to 1 for the years in which the subject was an Amherst student. Student status, not surprisingly, delayed marriage significantly.

One can estimate the magnitude of the effect of each variable on marriage probability.[5] The influence of body size on marital prospects was more clearly evident in its effect on time to first marriage than on the probability of ever marrying. For example, being underweight reduced the probability of ever marrying by 4%, but reduced the conditional probability of impending marriage by 12%. Similarly, overweight men were 7% more likely ever to marry than were men of the recommended weight, but were 16% more likely to marry soon. Very short men were 11% less likely ever to marry, and 45% less likely to marry soon; very tall men were 15% more likely ever to marry, and 40% more likely to marry soon. Thus body size exerted substantial effects on marital prospects, and particularly on the conditional probability of marrying in a given year.

The association of moderately larger body size with greater marriage probabilities could be due to three factors. First, for reasons embedded in the culture of the day, larger men may have been regarded as more physically attractive by their prospective wives. Second, size may have been interpreted as a signal of future earnings capacity. The relationship between height and productivity, and thus income, has been established elsewhere, as noted previously. Among Amherst graduates who became physicians, attorneys, teachers, and ministers, the tallest men became attorneys; in 1929 these were the best paid of this group. The shortest became ministers, who had the lowest average income of the group.[6] Because attorneys had the smallest marital probabilities and ministers the largest, height as a signal of expected future income may have been relatively unimportant to these men's future wives.

A third explanation for the relationship between anthropometrics and nuptiality is that body size is a visible signal of health to which prospective wives would pay attention. Fu and Goldman (1996) used categorical measures of height and BMI that were similar to those used here. In their study of first marriage rates for both men and women from 1979 to 1991, their results were similar to those found in this study. Underweight men's marriage hazards were significantly lower than those for men of recommended weight; those for overweight men were significantly larger. The authors interpreted a prospective spouse's BMI as a signal of his or her future health prospects. Consistent with this hypothesis was their finding of a lower marriage hazard for men in the largest BMI category (obese) than for men in the next lowest category (overweight). Similarly, Table 2 shows a lower marriage hazard for the obese than for the merely overweight.

Choice of career was associated with different marriage probabilities. I assigned categorical variables for career on the basis of the field in which the subject spent most of his working life according to the *Biographical Record*. Graduates who entered the ministry were more likely ever to marry and to marry relatively soon, in the sense that all other men had significantly lower marital probabilities. Early marriage among the clergy may have been due to the prestige or value of having a wife to assist in serving a congregation, or perhaps to a preference for family and job stability. It was probably not due to employment as a minister immediately after graduation: The *Biographical Record* suggests that most (although not all) prospective ministers sought further education after Amherst in divinity schools, much like doctors and lawyers in medical or law schools.

THE PROTECTIVE EFFECT OF MARRIAGE IN TERMS OF MORTALITY

The anthropometric measures of the Amherst men provide an estimate of overall health and nutrition in early adulthood, which influenced the timing of their marriages as described above. Measures of body size and the timing of marriages have both been hypothesized to affect longevity. Duration models that analyze the time to death can be estimated as described above to assess the relative contributions of health and marital status to longevity. The present findings suggest that the effects of health in young adulthood and of marriage operated independently in influencing longevity.

Modeling the effect of marital status on longevity is a difficult problem. Unmarried men's early deaths may have been caused by factors unrelated to their bachelor status. One strategy for addressing this problem is to begin the risk period of death at a certain age and to eliminate sample members who died before that age (Hacker 1997). This approach might control for problems of early deaths that are due to causes unrelated to either height or BMI. Yet the loss of information due to the deletion of those early deaths could potentially bias the results (Allison et al. 1997).

In the present analysis I use Cox proportional-hazard regressions extended outward in time from age 18 to the subjects' death. As noted above, none of the mortality observations were censored except those of the very few men who were still alive in 1963, when the *Biographical Record* was published. These accounted for just 53 of the 1,937 men with known marriage dates. Table 3 shows the estimated regression coefficients for three models, which differ in the method for modeling marital status. Model 1 omits marital status; Model 2 uses a dummy variable set equal to 1 if the man was ever married; and Model 3 uses a time-varying regressor set equal to 0 before the subject was married and to 1 after his

5. See Maddala (1983:23) for the logit formula. For proportional hazard models the marginal effect is estimated by exponentiating the coefficient estimate. Here I estimated marginal effects from Model 3.

6. In *Historical Statistics* (U.S. Bureau of the Census 1976), the average attorney's income in 1929 was estimated at $5,534 (series D 914); the average clergyman's income was estimated at $1,826 in 1926 (series D 793). The average height of future ministers in the Amherst sample was 172.95 cm; that of future attorneys was 173.43 cm.

TABLE 3. REGRESSION MODELS OF MORTALITY

	Model 1		Model 2		Model 3	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Married			–0.63**	0.07	–0.16**	0.08
Body Mass Index						
Underweight	0.002	0.05	–0.01	0.05	0.02	0.05
Recommended	Omitted		Omitted		Omitted	
Overweight	–0.02	0.09	–0.001	0.09	–0.01	0.09
Obese	1.48**	0.36	1.53**	0.36	1.38**	0.41
Height						
Very short	–0.12	0.17	–0.31†	0.17	0.03	0.13
Short	0.08	0.07	0.05	0.07	0.07	0.07
Medium	Omitted		Omitted		Omitted	
Tall	0.07	0.07	0.03	0.07	0.05	0.07
Very tall	–0.01	0.14	0.04	0.14	0.003	0.14
Occupation						
Business	0.22**	0.07	0.19**	0.07	0.22**	0.07
Teacher	0.06	0.07	0.005	0.07	0.06	0.07
Lawyer	0.30**	0.08	0.21**	0.08	0.29**	0.08
Physician	0.27**	0.09	0.20*	0.09	0.25**	0.09
Minister	Omitted		Omitted		Omitted	
Other	0.21*	0.09	0.11	0.09	0.19*	0.09
Birth Cohort						
1830–1839	0.07	0.11	0.03	0.11	0.06	0.11
1840–1849	0.07	0.07	0.08	0.07	0.06	0.07
1850–1859	0.06	0.07	0.04	0.07	0.05	0.07
1860–1869	–0.10	0.06	–0.09	0.06	–0.12*	0.06
1870–1879	Omitted		Omitted		Omitted	
–2 Log-Likelihood	25,226		25,157		25,411	
N	1,961		1,961		1,937	

Notes: Dependent variable was equal to number of years from age 18 to death. Marital status in Model 2 is a dummy variable set equal to 1 for those ever married and to 0 for lifelong bachelors; in Model 3 it is a time-varying regressor set equal to 0 before the subject was married and to 1 when he married. Difference in sample sizes is due to availability of date of marriage; for 24 men the date was unknown, but the *Amherst College Biographical Record* reported that they had married at some time in their lives.

†$p < .10$; *$p < .05$; **$p < .01$

first marriage. The coefficient estimates indicate the effect of the independent variable on the hazard of mortality: that is, the probability of death in a particular year, given survival up to that year.

By either definition of marital status, marriage significantly reduced the conditional probability of death. Among those men who were ever married, the conditional mortality risk was reduced by about half (47%) compared with that of lifelong bachelors. A finer measure of marital status, the time-varying regressor that was set equal to 1 when a man married, suggested about a 15% reduction in mortality risk. In both cases the protective effect of marriage was evident in the Amherst sample. It is noteworthy that the blunter measure of marital status exerted the greater effect on mortality risk. It may have been that bachelors' greater mortality risk was due to the cumulative effect, over many years, of increased morbidity or psychological stress.

The effect of body size on mortality prospects was limited to the effect of obesity, the only category that consistently generated significant coefficients. Obese men were much more likely to die soon than were men of the recommended weight for height. The broad similarities in sign, magnitude, and significance across the body size regressors, without regard to inclusion or definition of the marital status variable, suggest that marital status and body size had largely independent effects on mortality risk. In the Amherst sample, then, selection into marriage occurred by body size; protection from mortality due to marriage was found; but only among the obese did I observe a connection between health status early in life and mortality risk later in life.

Elevated mortality risks among men with extremely high BMI values but not among men with lower BMI values, as well as the apparent absence of a significant relationship between height and mortality risk, are consistent with some present-day studies such as Allebeck and Bergh (1992). This pattern was somewhat different from the U or J shapes found in some other studies. In an earlier study (Murray 1997), I found U-shaped BMI-mortality risk patterns in the Amherst sample that resembled those found in studies of present-day young men. That version of the Amherst data included graduates and nongraduates alike, and the Amherst risk period was adjusted to match those of modern studies used for comparisons. With a mortality risk period extending 10 years from measurement, Amherst men and present-day Norwegian men (Waaler 1984) displayed similarly elevated risk if their BMI values were less than 20 and more than 26. With a window of 32 years, elevated risk occurred at BMIs of less than 19 and more than 25 for both the Amherst men and a sample of Dutch men (Hoffmans, Kromhout, and De Lezenne Coulander 1988).

Epidemiologic research suggests that the difference in mortality patterns between the two Amherst samples may have been due to differences in sample composition. One reason for the absence of a U-shaped relationship between BMI and mortality may have been the deletion of nongraduates from the present sample. Nongraduates' mortality in the years just after their class graduated was relatively high, suggesting that they may have suffered from occult disease. When these nongraduates were eliminated, the effects may have been similar to the effects of deleting subjects who died in the first few years of follow-up. This research strategy can eliminate the elevated mortality risk for those in the left-hand tail of the BMI distribution (Allison et al. 1997). Unfortunately, because consistent marriage data were lacking for the nongraduates, their deletion was necessary for a study of causes and effects of marriage.

Choice of career influenced mortality risk. In general the risk was lowest among ministers and teachers, and highest among physicians and attorneys. This pattern is remarkably similar to the relationship between occupation and mortality risk found by Hacker (1997) in his study of eighteenth-century Yale graduates. Physicians' exposure to infectious diseases could account for their elevated risk, but the reason for attorneys' greater risk is not clear. I found only weak period effects: The mortality risk of the 1860s' birth cohort was significantly lower than those of earlier or later cohorts.

CONCLUSIONS

Present-day studies indicate that selection into marriage can occur by health status. Others show that marriage decreases mortality risk. How much of that decreased mortality risk is due to the greater probability of marriage among the healthy, who are at lower risk of mortality? Testing for effects of both marriage and early adulthood health on mortality risk is simplified by historical data: that is, by records of persons whose lives are completed. A longitudinal data set with a window of observation lasting so many years that all members of the sample are deceased is historical by definition.

In this study I used such a sample to separate the influences on nuptiality, in terms of health, from the influences on mortality, in terms of nuptiality and health. In the present data, taller men married sooner, as did men who were somewhat bulkier than average (but not those who were much more obese). The distinction between *overweight* and *obese*, although consistent with present-day studies, was important empirically because combining the two categories into one resulted in insignificant coefficients for the combined variable in the regressions for both nuptiality and mortality.

With the available information, we can only speculate on the reasons for selectivity into marriage. Perhaps the larger men were viewed by their brides as more handsome, or perhaps their greater size was interpreted as suggesting that they could produce a larger income or that they were unusually healthy. Moreover, reasons for selectivity could well have changed as a birth cohort aged. Factors unobservable here—for example, poor hygiene, physical disabilities, or excessive risk taking—could have delayed marriage while increasing risk of mortality, and the effects of such unobservables may have changed through the lifespan (Lillard and Panis 1996). Although the selective and protective processes have been shown to occur through body size, other personal characteristics may have influenced the probabilities of both nuptiality and mortality.

Because marriage induced lower mortality in this study even with controls for health status in adulthood, the effect of marriage on mortality risk must have been independent of early health status. This effect could have been related to higher incomes received by the married, or it could have operated through the care and companionship given by one's spouse (Waite 1995). Particularly in the latter case, where marriage prolongs life more directly, the loss of that protection through death or divorce should lead to greater mortality risk. Although I could not take that approach using the present data set, it suggests an avenue for further research that would help to clarify the relationship among health, nuptiality, and mortality.

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