The association between education and health among working-age adults: An examination of quantity versus credentials effects.

Anna Zajacova, University of Michigan
Robert A. Hummer, University of Texas at Austin

Abstract.
We analyze two dimensions of educational attainment in terms of their association with self-rated health among working-age adults: quantity (years of schooling) and degree credentials. A better understanding of these two dimensions may be crucial for a deeper understanding of educational effects on health. Multivariate logistic models of dichotomized self-rated health are employed on data from the National Health Interview Survey 1997-2006 comprising 303,137 adults aged 30-65. The results show a clear gradient in health across the entire education range. We find a significant effect of a college degree and an even stronger effect of a high school diploma on reporting poor/fair health, net of years of schooling. Both quantity and credentials have independent effects on general health in different population groups. We discuss the importance of disentangling the two dimensions of schooling and speculate on the causal as well as selection pathways that link education and health.

EXTENDED ABSTRACT

The strong association between education and health outcomes for American adults has been well documented. The causal pathways through which high education confers health and longevity advantages have been studied extensively but are not yet fully understood. One crucial aspect of the education-health association concerns the question of whether quantity of schooling or earned credentials matter more for converting education into good health.

QUANTITY VERSUS CREDENTIALS

The human capital approach (Becker 1964) suggests that education confers a range of skills and abilities that are rewarded in the labor market in higher employment rates and income. In social epidemiology, we can extend this perspective to consider the skills and abilities rewarded within the wider social context. The abilities may range from job-specific skills to more general cognitive aptitude skills such as logical and rational thinking, efficient planning of future actions, and complex problem solving. Schooling may also improve non-cognitive skills such as self-efficacy or mastery beliefs, the ability to delay gratification, positive work attitudes, and self-motivation. All these skills combine to improve an individual's human capital, and they all have direct and indirect links to health outcomes. For instance, the cognitive skills learned in school are related to better processing of health information, adhering to medical advice, and better coping with stress. These skills in turn are associated with better health outcomes (Mirowsky and Ross 2003).

The credentialing perspective, also referred to as signaling, suggests that the main impact of education is not through gained knowledge and skills but through the labor market advantages conferred to the individual holding a diploma (Arrow 1973; Spence 1973). In the extreme, this view claims that education as such does not provide students with any transferable skills net of credentials (Collins 1979), although this argument has been applied more with respect to the labor market than the broader context in which health trajectories are shaped.

In 1997, the National Health Interview Survey, a major ongoing survey considered the main source of information about health status in the U.S. population, changed the way they asked questions about respondents' education. Prior to that time, the interviewers asked about the highest year of schooling respondents completed so education was measured in single years from 0 to 18 or more. Since 1997, the survey has asked about years of schooling up to the 12^{th} grade and about the highest attained educational *credential* at the secondary level and above. This current approach to measuring education is better suited to the current trends in educational attainment among U.S. adults. First, the number of years students need to achieve postsecondary degrees has increased and become more variable, so that the average time to a BA is about 5 years rather than 4 (NCES 2003; NCES 2007). Thus information about the outcome of the educational trajectories in the form of a degree may be more informative than the length of time

needed to achieve it.[1] Second, the overall level of education in the population increased dramatically over recent decades (Hill and Needham 2006). The majority of young adults now attend at least some postsecondary schooling, although many drop out before attaining any degrees. Therefore, a detailed understanding of how postsecondary educational credentials relate to health outcomes is more important in the current working-age populations than for older birth cohorts among whom a large proportion of population completed 12 or fewer years of schooling.

The new NHIS data provide a unique opportunity to test the quantity versus credentials perspectives with respect to health outcomes. We analyze self-rated health among working-age adults as a function of years of schooling and credentials. The human capital perspective predicts that years of schooling will have a significant effect on health without any marked discontinuities associated with reported credentials. The credentialing perspective suggests that only credentials will have effect on health. Because the dataset does not include both years and credentials at the full education range, the two perspectives are best distinguished at specific places along the range of educational attainment levels. Specifically, we will focus on

1) different credentials that require about the same years of schooling or equivalent cognitive abilities, but are associated with different non-cognitive factors or with different occupational tracks, such as a high school diploma versus GED, or an academic versus technical associate's degree.
2) points along the education continuum where students attended more years of school but did not earn a credentials: up to 12 years without a high school diploma versus a 11 years or a high school diploma, and having 'some college' but earning no degree versus a high school diploma and an associate's degree. According to the credentialing perspective, there should be little effect of the additional schooling when no diploma has been earned, while the human capital perspective will predict a significant effect on health of the greater quantity of schooling.

From a public policy view, the group of individuals with some college but no diploma deserves special consideration. This group has been increasing rapidly – well over 25% of young adults fall into this educational category (U.S. Census Bureau 2004). College attendance imposes high costs in terms of time, foregone income, and tuition, and it is important to know whether the students gain health advantages even if they do not complete any degrees.

DATA AND METHODS

Data Source

[1] It is not clear, however, how respondents answer question about the years of schooling they completed. We studied the degree of heaping in the distribution of educational attainment around the credentialing years across different time periods and population groups to gain insight whether individuals who complete a degree, say a BA, in more years than 16, report the actual number of 16. The heaping around credentialing years in data where education is measured in completed years suggested that respondents answer the 'competed years' question in terms of the 'expected' number of years necessary for a completion of a given degree.

The analyses are based on the National Health Interview Survey (NHIS) for the years 1997-2006. The NHIS is an annual health survey conducted through face-to-face household interviews by the National Center for Health Statistics (NCHS). NHIS uses a complex multistage stratified sampling design to obtain a sample representative of the civilian non-institutionalized U.S. population. The total household response rate has been almost 90%, although it declined somewhat in recent years (CDC, 2002).

Sample

The analysis sample includes all non-Hispanic U.S.-born white and black adults with non-zero sampling weights, age 30 to 65 at the time of the interview. From this group, 3.2% had missing information on education and an additional 0.36% had missing data on self-rated health. These observations were excluded from analyses. There were no missing values on age, gender, race, region, and year of interview. The total analysis sample thus comprises 303,782 respondents.

Variables

Education. Information about education was asked in terms of completed grades for respondents with less than a high school degree and in terms of attained credentials for those with completed secondary or any postsecondary education. During the interview, the respondents were handed a card with all educational categories and asked to place themselves in the appropriate category. We collapse categories for grades 0-4 and 5-8 because of small number of observations in each individual primary-school grade. Detailed information about the collection of the education variable is available elsewhere (NCHS 1997, pp. 164-65).

Health. Self-rated health was assessed using the standard 5-point scale from excellent, very good, good, fair, and poor. The variable is dichotomized as excellent to good and fair/poor.

Control variables. All multivariate models adjust for, or stratify on, age measured in single years and centered on the sample mean of 46 years, gender (male is reference), race (non-Hispanic white is reference), region of residence coded as Northeast (reference), Midwest, South, and West, and the year of interview centered on the mean year of 2001.

Analyses

First we use simple univariate descriptive analyses to present in detail the distribution of the main variables, education and health, for each race and gender group. Next we estimate a series of multivariate logistic regression models of dichotomized health on education, adjusting for the set of controls listed above. We also convert the credentials into the number of years typically needed to attain the degrees and estimate models of health on years of schooling using these converted numbers. We then added dummy variables for credentials, allowing discontinuities in the slope estimate at the credentialing years. Some models are stratified on race and gender. Results are presented in tables and graphically using figures. All univariate and multivariate analyses fully adjust for sampling design using the svy suite of commands in Stata 10.1 (StataCorp 2007). We conducted a number of sensitivity analyses to understand the impact of our choice of threshold for the self-rated health variable. We compared results from the presented logistic regression models on health dichotomized in the standard way as excellent to good, and fair to poor, against results from models on health dichotomized as excellent to very

good, and good to poor, and to ordered logistic regression models on the full 5-point variable. The results were substantively equivalent, although the gradients were marginally smaller using both alternative specifications of the health variable.

PRELIMINARY RESULTS

Table 1 presents the distribution of key independent and dependent variables for the analysis sample by race and gender, as well as for the aggregate group. The sample included 52% women and 13% non-Hispanic black adults. The average respondent was 46 years old. For the sample as a whole, the distribution of education showed that only about 2 percent of respondents completed 0-8 years of schooling. The modal education category was high school diploma. Respondents who completed a BA and those who attended some college but did not complete any degrees comprised similarly sized groups, with roughly 18% each. About 10% of the adults had an AA, 7.5% had a Master's degree, and 2.8% reported obtaining an MD, JD, PhD, or EdD. There were significant group differences in the distribution of educational attainment (a chi-squared statistic corrected for survey design for group differences in the distribution of education was significant at $p<.000$). Black adults had significantly lower average education, 12.8 years, compared to white adults with 13.7 years. Black women had significantly higher educational attainment than black men, although the substantive difference was only 0.3 of a year. In general, men of either race group were more likely to have very low and very high levels of education than women. Results for the descriptive statistics not included in Table 1 are available from the authors.

Table 2 presents a detailed set of results of the effect of each educational level relative to a high school diploma on the odds of reporting poor/fair health, for the sample as a whole and by race and gender. The table shows a clear, strong, and highly significant gradient in health across the full education spectrum for all demographic groups. The effects are substantively large: relative to someone with a high school diploma, an individual with a BA has 66% lower odds of reporting fair/poor health, for MA the odds are 75% lower, and for respondents with 11 years of schooling the odds are 150% higher. Individuals with some college and no diploma report significantly better health (17% lower odds of fair/poor health) than those with any secondary degrees, but they are worse off than the lowest credential group, those with a technical AA, except among black males.

Figure 1 graphically shows these effects on a log-odds scale (the odds scale has a limit of zero that distorts the inspection of the pre-secondary versus post-secondary patterns). The figure shows a clear gradient for years of education at the presecondary levels prior to credentialing years, as well as a large effect of credentials. There is a significant difference between a GED and a high school diploma – in fact, respondents with a GED are more likely to report poor/fair health than those with 12 years of schooling without any credential. There is also a statistically significant difference between the academic and technical AA degrees. Overall, the figure

suggests that both additional years of schooling and higher credentials are associated with better health.

Table 3 offers more a formal test of the independent effects of quantity and credentials. The table shows the effects of credentials net of years of education (where the credentials have been converted into the typical number of years needed to attain them when studying full-time). The first column shows that each year of education is associated with 23% lower odds of reporting poor/fair health. This effect is very strong but it is in the range reported previously (i.e., Hill and Needham 2006) and is due to the large differences in crude probabilities in reporting poor/fair health across the different educational levels (see Table 4). Net of years, a high school diploma is associated with an additional 'jump' of 50% lower odds of reporting poor health – a pattern clearly visible in Figure 1. The effect of an AA degree is significant but much smaller in magnitude (6% lower odds, when in the final model) and the BA effect is also significant and substantial at 34% lower odds. The MA is not associated with any additional effects net of years of schooling and the lower credentials.

Table 4 shows the predicted probability of reporting fair/poor health by education at the mean values of the control variables, for the sample as a whole and for each race and gender group. Figure 2 displays the results graphically for the full sample. The absolute differences in the probability of reporting fair/poor health are very large: respondents with any postsecondary education have just a 2-7% probability of reporting poor/fair health. The probability rises precipitously to 16% for those with a GED and further to about 30% for those with the lowest level of education.

TOPICS FOR CONTINUED WORK/DISCUSSION

We will discuss why both years of schooling and credentials play a role in general health. There is difficulty in disaggregating these two dimensions of schooling, especially given that the NHIS dataset does not include the years of schooling for those with attained credentials. We will consider how quantity of education is related to, but not equivalent with, the content and quality of education, and how it is related to, and distinct from, the attained credentials.

We will compare our findings to the seminal paper by Ross and Mirowsky (1999), who analyzed the effects of educational quantity, credentials, and college selectivity on general health and functional limitations albeit using a much small sample of individuals than we employ here.

We will carefully consider age and cohort effects in the effects of education, using simple cohort-stratified analyses and applying mixed-model APC approach proposed recently by Yang and Land (2006; 2008).

Finally, we will offer suggestions for obtaining further information on schooling effects by including additional questions concerning attained education in health surveys.

Table 1. Key characteristics of the analysis sample, by gender and race: NHIS 1997-2006.

	Whole sample	White men	White women	Black men	Black women
N	303,782	123,758	130,994	20,530	28,500
Age (mean)	46.0	46.1	46.2	44.7	44.8
Education					
0-4	0.40	0.40	0.30	0.89	0.61
5-8	1.74	1.90	1.36	3.02	2.20
9	1.30	1.35	1.10	1.91	1.80
10	2.23	2.01	1.95	3.93	3.98
11	2.65	2.36	2.05	5.36	6.05
12	1.93	1.76	1.63	3.65	3.51
HS diploma	29.00	27.94	29.17	34.50	30.15
GED	2.73	2.94	2.56	2.86	2.43
Some college	18.35	17.19	18.74	19.89	21.77
AA technical	7.05	6.98	7.35	5.81	6.56
AA academic	3.71	3.05	4.48	2.79	3.65
BA	18.57	20.05	19.17	10.83	11.69
MA	7.53	7.84	8.19	3.39	4.71
MD, JD	1.67	2.52	1.15	0.67	0.51
PhD, EdD	1.13	1.71	0.77	0.49	0.38
Health					
Excellent	31.32	33.55	31.69	24.91	20.36
Very good	33.62	34.29	34.40	28.80	28.35
Good	24.40	22.93	24.03	29.36	31.91
Fair	7.89	6.77	7.32	12.64	14.65
Poor	2.76	2.46	2.55	4.28	4.73

Note: The analysis sample is defined as non-Hispanic white and black adults age 30-65 at interview with non-missing values on education and health and non-zero weights.
All means and proportions are weighted.

Table 2. Odds ratios of reporting fair or poor health, by race and gender: NHIS 1997-2006.

	Whole sample	White men	White women	Black men	Black women
Age	1.05***	1.05***	1.04***	1.06***	1.05***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Midwest	1.11***	1.13***	1.10***	1.21**	1.03
	(0.03)	(0.05)	(0.04)	(0.11)	(0.07)
South	1.46***	1.54***	1.40***	1.23**	0.91*
	(0.04)	(0.06)	(0.05)	(0.10)	(0.05)
West	1.21***	1.26***	1.27***	1.19*	1.08
	(0.04)	(0.06)	(0.05)	(0.12)	(0.08)
Year of interview	1.03***	1.02***	1.04***	1.02*	1.01
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
0-4	4.22***	4.98***	3.54***	3.49***	2.85***
	(0.28)	(0.55)	(0.42)	(0.54)	(0.44)
5-8	5.11***	4.86***	6.28***	3.25***	3.95***
	(0.19)	(0.25)	(0.38)	(0.33)	(0.41)
9	3.85***	3.59***	4.29***	3.45***	3.37***
	(0.15)	(0.21)	(0.26)	(0.39)	(0.39)
10	3.00***	2.90***	3.10***	2.51***	2.42***
	(0.09)	(0.15)	(0.16)	(0.22)	(0.19)
11	2.51***	2.44***	2.44***	1.89***	2.10***
	(0.08)	(0.13)	(0.12)	(0.15)	(0.13)
12	1.49***	1.49***	1.43***	1.24*	1.27***
	(0.06)	(0.11)	(0.10)	(0.14)	(0.10)
GED	2.04***	2.13***	2.27***	1.55***	1.38***
	(0.06)	(0.10)	(0.11)	(0.18)	(0.13)
Some college	0.83***	0.82***	0.85***	0.77***	0.76***
	(0.02)	(0.03)	(0.03)	(0.05)	(0.03)
AA technical	0.77***	0.75***	0.81***	0.81**	0.72***
	(0.02)	(0.04)	(0.03)	(0.08)	(0.06)
AA academic	0.57***	0.59***	0.57***	0.52***	0.54***
	(0.03)	(0.04)	(0.04)	(0.09)	(0.06)
BA	0.34***	0.34***	0.35***	0.39***	0.39***
	(0.01)	(0.01)	(0.01)	(0.04)	(0.03)
MA	0.25***	0.23***	0.26***	0.40***	0.33***
	(0.01)	(0.01)	(0.01)	(0.08)	(0.04)
MD/JD	0.21***	0.20***	0.28***	0.19***	0.19***
	(0.02)	(0.03)	(0.05)	(0.08)	(0.08)
PhD	0.25***	0.23***	0.29***	0.28***	0.38*
	(0.02)	(0.03)	(0.05)	(0.12)	(0.19)

*** p<0.01, ** p<0.05, * p<0.1

Table shows odds ratios (standard errors). All models are adjusted for sampling design. High school diploma is the reference category for education.

Table 3. Effect of years of schooling and credentials on health, full sample: NHIS 1997-2006.

Age	1.05***	1.05***	1.05***	1.05***	1.05***
Female	1.10***	1.12***	1.12***	1.11***	1.11***
Black	1.83***	1.80***	1.79***	1.78***	1.78***
Years	0.77***	0.83***	0.85***	0.87***	0.87***
High school		0.51***	0.50***	0.47***	0.47***
AA			0.80***	0.94**	0.94**
BA/BS				0.66***	0.66***
MA/MS					1.00

Shown are odds ratios; for parsimony standard errors not shown. The models also control for region of residence and the year of interview; education is centered around 12 years. All models are adjusted for sampling design. The credentials are coded 1 if respondent attained the degree or a higher one, and zero otherwise.

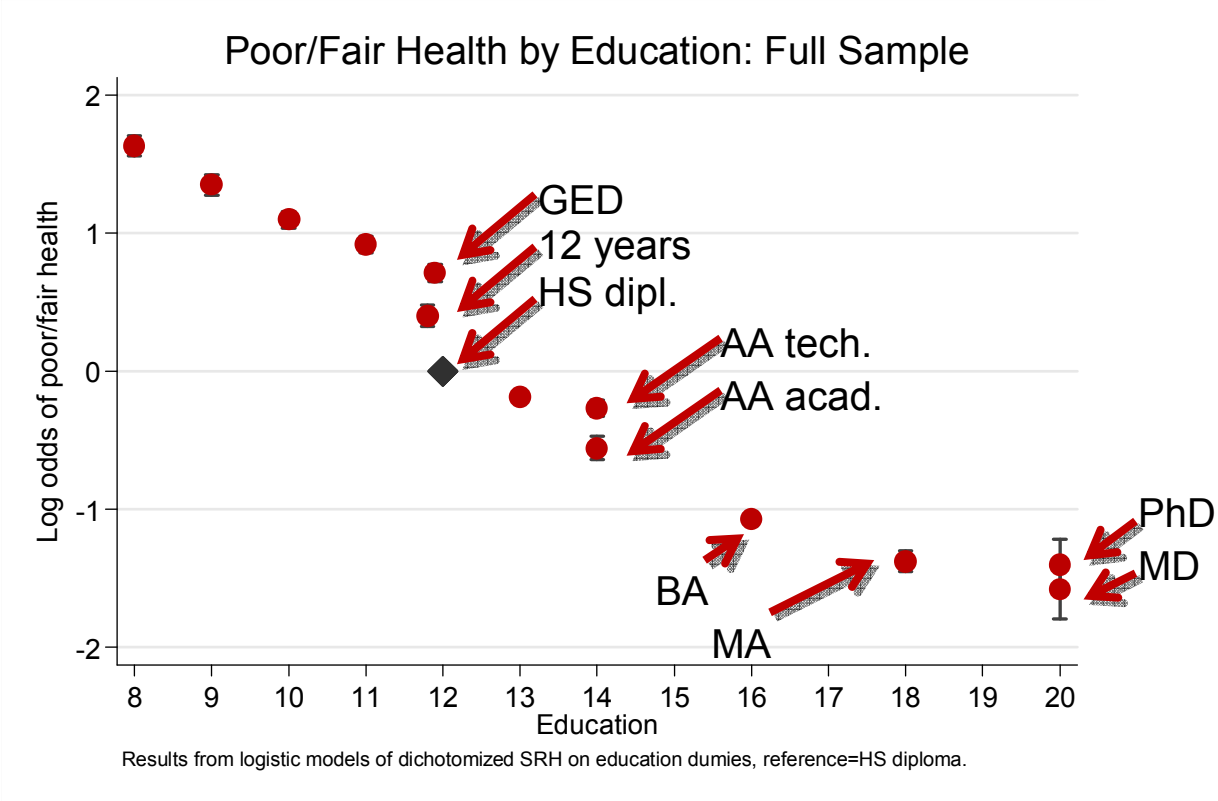
*** p<0.01, ** p<0.05, * p<0.1

Table 4. Predicted probability of reporting poor or fair health, by gender and race: NHIS 1997-2006.

	Full sample	White men	White women	Black men	Black women
0-4	0.29	0.28	0.24	0.36	0.42
5-8	0.33	0.28	0.36	0.34	0.50
9	0.27	0.22	0.28	0.35	0.46
10	0.22	0.19	0.22	0.28	0.38
11	0.19	0.16	0.18	0.23	0.34
12	0.13	0.11	0.11	0.16	0.24
HS diploma	0.09	0.07	0.08	0.14	0.20
GED	0.16	0.14	0.17	0.20	0.26
Some college	0.07	0.06	0.07	0.11	0.16
AA technical	0.07	0.06	0.07	0.11	0.15
AA academic	0.05	0.04	0.05	0.08	0.12
BA	0.03	0.03	0.03	0.06	0.09
MA	0.02	0.02	0.02	0.06	0.08
MD, JD	0.02	0.02	0.02	0.03	0.05
PhD, EdD	0.02	0.02	0.03	0.04	0.09

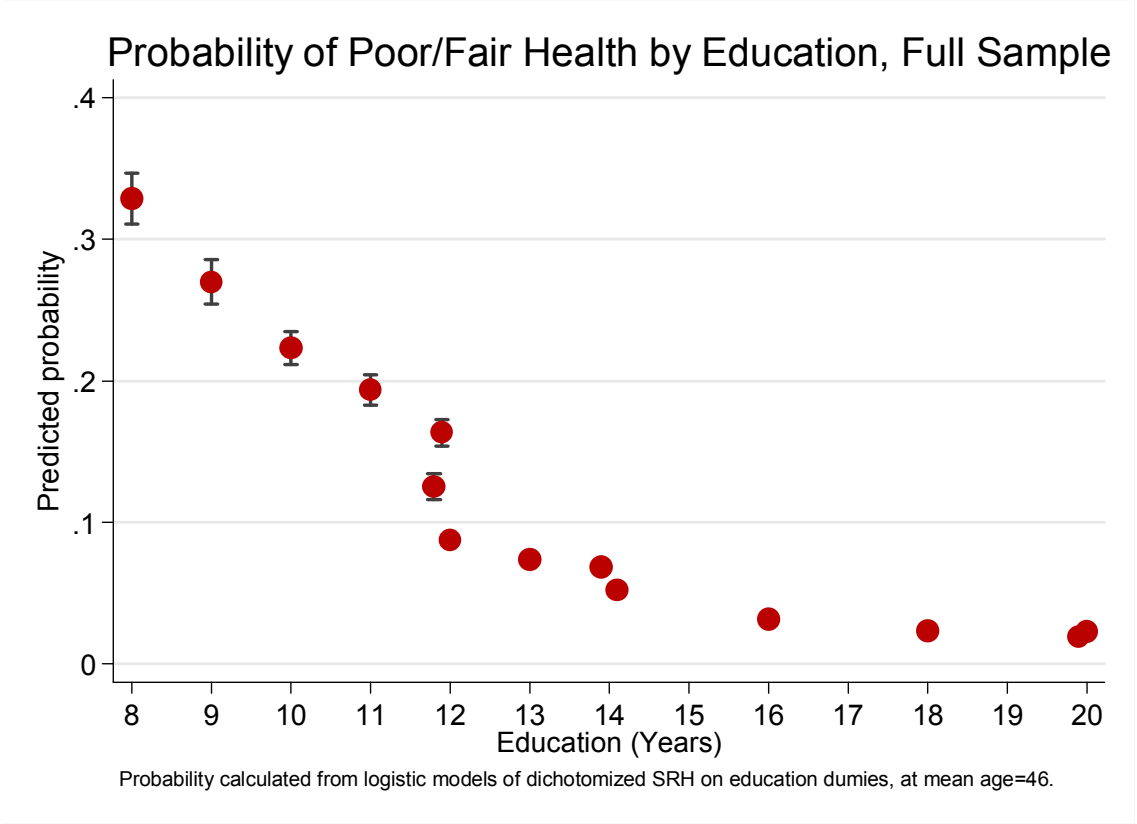
Note: the predicted probabilities are calculated on the basis of estimates from sex- and race-stratified logistic models of dichotomized health on age, region, year of interview, and education. The probabilities are predicted for age=46 years.

Figure 1. Log odds of reporting poor/fair health, by education: whole sample, NHIS 1997-2006



Note: the figure shows the log-odds of reporting poor/fair health for each level of educational attainment relative to having a high school diploma (gray diamond). All credentials are marked on the figure. "Some college" is placed above 13 on the education axis, and below 12 years the levels mark years of completed schooling.
The format will be changed for publication. The current format was intended for a PowerPoint slide.

Figure 2.


Probability of Poor/Fair Health by Education, Full Sample
Predicted probability
.4
.3
.2
.1
0
8
9
10
11
12
13
14
15
16
17
18
19
20
Education (Years)
Probability calculated from logistic models of dichotomized SRH on education dumies, at mean age=46.