ADOLESCENT PERSONALITY, COGNITIVE ABILITY, AND ADULT MORTALITY:
A Pilot Study from Project Talent

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Purpose

This paper represents a feasibility/pilot study designed to inform a recently submitted funding proposal to test the effect of personality and cognitive ability on mortality in over 100,000 members of the Project Talent Study (Roberts et al., 2013). The analyses presented in this paper were intended to investigate the proposed analytic strategies, identify resources needed for, and evaluate the types of research questions that can be addressed in a full-scale study. The results informed the proposal and showed sufficient promise to merit presentation.

Introduction

Research has established relationships between cognitive ability, personality, and survival (Kern & Friedman, 2008; Roberts et al., 2007). Schwartz et al. (1995) and Friedman et al. (1995) showed that childhood personality predicted longevity, particularly for males. Friedman et al. (1995) showed that conscientiousness in childhood predicted longevity even after controlling for health behaviors such as smoking, alcohol consumption, and overeating. Results from the Vietnam Experience Study (Batty et al., 2007; Batty et al., 2009) have shown that late adolescent IQ predicted both midlife all-cause mortality and mortality due to cardiovascular disease in men. Similarly, Jokela et al., (2009) showed that childhood IQ predicts midlife mortality. Deary et al. (2008) showed that childhood measures of intelligence and personality, when considered together, independently predict mortality, with higher intelligence and greater dependability associated with lower mortality risk.

Despite the accumulation of research studies suggesting that both personality and cognitive ability influence longevity, very few are based on analyses of nationally representative samples, leaving the question of the mechanisms by which these factors affect longevity still in doubt. Deary (2005) proposes possible explanations, including the role of socioeconomic status and health knowledge and behaviors as mediating factors, cognitive ability as a mediator of preceding (genetic and environmental) events, or as an indicator of "system integrity," denoting the body's general health. Others argue that personality factors, reflected in "attitudinal and behavioral patterns," directly affect mortality and fully explain the effects of cognitive ability (Hauser & Palloni, 2010). However, because of the relative lack of data that contain direct assessments of cognitive ability and personality, the pathways by which personality and cognitive ability affect mortality remain speculative.

Although many studies suggest the mechanisms by which cognitive ability and personality affect mortality, the issue is most appropriately addressed using a large, nationally representative sample containing extensive demographic data along with rich measures of cognitive ability and personality administered in childhood. Such a data source can be used to determine the effects of early life experiences, family background, personality, and cognitive ability on subsequent mortality across the life course.

Recent work using data from Project Talent (PT) (www.projecttalent.org) examined the mechanisms through which cognitive ability and personality operate on longevity (Stone et al., 2011; Bradley & Zhang, 2012). The present analysis will address the following questions:

1) What are the effects of personality and cognitive ability on mortality from adolescence until early old age? 2) Do these effects vary over the lifespan? and 3) How are personality and cognitive ability related to cause-specific mortality?

Theoretical Background

The relationship between cognitive ability and mortality has been studied at length since the 1980's, and research shows a consistent relationship between cognitive ability and longevity (Batty, Deary, & Gotfredson, 2007). Regardless of the time point at which cognitive ability is measured, and across a range of different measures, researchers have consistently found that greater cognitive ability predicts mortality, including all-cause and cause-specific mortality. Liu et al. (1990) found that cognitive ability measured in adulthood predicted mortality over an 8-10 year span in a sample of over 2,000 participants in the Framingham Heart Study. They found that adults who scored in the bottom quartile on a composite score of cognitive ability had relative risks of mortality between 1.3 and 1.7 times higher than those who scored in the top quartile. Wilson et al. (2009) studied a sample of older adults in the Chicago area, and found that cognitive ability was inversely related to mortality over a 14-year span. They found that the association did not differ for whites and blacks, but that it was stronger among the older adults in their sample, and the relationship was more pronounced for their measure of perceptual speed than it was for other cognitive measures assessed. Hart et al. (2003), in their analysis of data from the Scottish Mental Studies, found that childhood IQ predicted mortality in a sample of adults first assessed at approximately age 11 in 1921, and then followed for 25 years starting in the mid-1970's. They found that a one standard deviation decrease in IQ was associated with a 17% increase in the risk of mortality over the 25-year period, and that after controlling for possible intervening factors, a 12% increase in mortality risk remained.

Cognitive epidemiologists propose different mechanisms by which IQ affects mortality. For example, Deary (2005) proposes four possible mechanisms that can help explain the IQ-mortality relationship: 1) higher IQ individuals attain higher levels of education and occupations that situate them in healthier environments, which decreases the risk of mortality; 2) higher IQ individuals engage in healthier behaviors, leading to increased longevity; 3) lower IQ reflects the effect of earlier (including pre-natal) insults to the brain, and 4) higher IQ is a reflection of a generalized level of "system integrity," which enables individuals to more effectively cope with future stresses and therefore increases longevity. Although researchers have consistently found a link between cognitive ability and longevity, there is less consistent evidence regarding these, or other possible causal mechanisms.

Osler et al. (2003) examined the relationship between early life SES, birth weight, childhood cognitive ability, and adult mortality in a longitudinal sample of Danish Males who were assessed at age 12 and whose mortality was determined as of 2002 (when the oldest would have been approximately 49 years old). They found that cognitive ability predicted mortality, even after controlling for early life SES and birth weight. Specifically, they found that men in the lowest quartile of ability were at higher risk of all-cause mortality between ages 15 and 49 than were males in the highest quartile. Hemmingsson et al. (2006) examined cognitive ability in late adolescence, early SES, later SES (at approximately age 35), and mortality over 30 years in a sample of Swedish males assessed at ages 18-22 and followed through mortality in 2000 (when the oldest would have been 51 years old). They found that cognitive ability predicted mortality, that controlling for early SES had little effect on the predictive power of cognitive ability, and that further controlling for mid-life SES had no effect on the relationship between cognitive ability and mortality. Kuh et al. (2004) assessed cognitive ability in a sample of males and females at age 8, along with measures of prior health and socioeconomic status (SES), later educational attainment and SES, and followed the sample through age 54. They found that men in the bottom quartile of cognitive ability were nearly twice as likely to die by age 54, but did not find an effect for women. Further, their analyses considered whether prior health and SES accounted for the observed relationship between cognitive ability and mortality. They found that both poor health and low SES in early childhood were associated with mortality, and that for men, these factors slightly attenuated the effects of cognitive ability on mortality, but that independent effects remained.

Researchers have emphasized the role of personality on longevity through behaviors (including, but not limited to, health behaviors) that maximize benefits and minimize risks to longevity (Bogg & Roberts, 2004) or through increased capability to successfully cope with negative events (Danner, Snowden, & Friesen, 2001). Over the past 30 years there have been a number of studies that address this question (Roberts et al.,2007), although, as with studies of cognitive ability and mortality, there are relatively few longitudinal studies of mortality that assess childhood personality. Hauser and Palloni (2010) propose that "the effects of IQ are mediated by variables that could be correlated with it, but also represent traits quite different from intellectual skills and are more suitably thought of as indicators of character and personality as well as behaviors during adulthood." In their analysis of data from the Wisconsin Longitudinal Study, they found that class rank consistently explained the effects of IQ on both health behaviors and subsequent mortality. They conclude that the "leading candidate to explain the IQ-survival relationship would appear to be lifelong attitudinal and behavioral patterns that contribute both to academic success in secondary school and to systematic accumulation of health benefits."

Danner, Snowden, and Friesen (2001) found that positive emotion assessed in early adulthood was associated with a decreased risk of death between ages 75-93, even after controlling for educational attainment. However, not all personality domains have produced consistent findings. For example, some studies have reported that neuroticism is associated with an increased risk of mortality (Christensen et al., 2002), whereas others have shown a protective effect of neuroticism (Friedman & Martin, 2011; Weiss & Costa, 2005). Research on the effects of hostility on mortality suggests the possibility of different results depending on the age at measurement. For example, while a number of studies show that hostility measured in adults is associated with an increased risk of mortality (e.g., Barefoot et al., 1995), results are more mixed in research where hostility is assessed at younger ages. Some research (e.g., Barefoot, Dahlstrom, & Williams 1983; Barefoot et al, 1989) shows that high levels of hostility in young adults are associated with increased risk of all-cause mortality, but other research (McCranie et al., 1986; Hearn et al., 1989) finds no such effect.

More recently, the personality domain of conscientiousness has been an area of research interest, and has been shown to predict decreased risk of mortality (Kern & Friedman, 2008). Weiss and Costa (2005) showed that conscientiousness is associated with decreased risk of all-cause mortality over five years in a sample of older adults (ages 65-100). Terracciano et al. (2005) followed adults ranging from 18 to 98 years of age over a 50-year period as part of the Baltimore Longitudinal Study of Aging, and found that conscientiousness (in addition to facets of extraversion and low neuroticism) predicted decreased risk of mortality, with these effects operating largely independent of other factors, such as smoking and obesity. Hill et al. (2011) showed an association between conscientiousness and mortality, even after controlling for demographic measures, cognitive functioning, and health conditions. They also found that conscientiousness did not predict health conditions, but did predict cognitive functioning, and suggested a possible indirect effect of conscientiousness on mortality, through increased cognitive ability.

The emergence of the Terman Life-Cycle Study, which followed a sample of intellectually gifted children from approximately age 11, provided researchers with a rich source of data on early life events and mortality. Friedman et al. (1995) examined personality, assessed at age 11, and mortality when surviving respondents would have been approximately 80 years of age. They found that personality, life stressors (such as parental divorce), and health behaviors (such as smoking and excessive alcohol consumption) maintained independent effects on mortality and did not show an indirect effect of personality on mortality through health-related behaviors. In a later analysis of the Terman data, Kern et al. (2009) examined the association between conscientiousness, occupational success, and mortality through approximately age 95. They found that both conscientiousness and occupational success predicted mortality and that conscientiousness attenuated the negative effects of low occupational success. Although studies based on the Terman data have shown the role of early personality in predicting longevity, the sample is restricted to intellectually gifted individuals, and is not representative of the national population.

Deary et al. (2008) examined data from the nationally representative Scottish Mental Survey of 1947. Children were assessed at age 11, and periodically re-contacted through 1963 (at approximately age 27); death was ascertained as of 2003. Their analysis showed that childhood dependability (comprised of perseverance, stability of mood, and conscientiousness) and intelligence predicted mortality, even after controlling for demographic factors such as educational attainment and later SES.

Researchers who have attempted to disentangle the effects of both cognitive ability and personality on mortality have faced difficulties due to insufficiencies in the available data, which limit the hypotheses that can be tested or the extent to which conclusions can be generalized to the population. Many longitudinal studies of mortality consist of cohorts of older adults at the time of sampling;

by the start of the study, a significant proportion of the birth cohort represented by the sample are already deceased, data must be gathered retrospectively, and cognitive decline may have already begun. Often these studies consist of samples that are limited in the population from which they are drawn (e.g., college students, intellectually gifted children, military veterans, or participants in health-related studies). There are some notable exceptions, including studies such as the Wisconsin Longitudinal study and the Scottish Mental Studies, but caution must be taken in applying conclusions drawn from these studies to the U.S. population, in part or in whole. Because of the difficulty of fielding a prospective, longitudinal study of aging, there are currently few studies that meet the necessary criteria – well-designed measures of both cognitive ability and personality, measures of early- life experiences, and a representative sample.

Methods

Sample

Data used in this study were from the 2011-12 Project Talent Follow-up Pilot Study (PTPS12). Project Talent (PT) is a large, nationally representative longitudinal study, which collected extensive cognitive, personality, and background information from 377,000 9th-12th graders in 1960. The Project Talent design included sampling approximately 1,200 schools that enrolled students in grades 9 through 12. Within the sampled schools, all students in grades 9-12 were selected to participate in two full days of data collection, including extensive testing of personality, knowledge, and abilities, and completion of an extensive demographic questionnaire. Follow-up surveys were administered at 1, 5, and 11 years after each grade cohort graduated high school (for more information on the Project Talent study design, see Wise, McLaughlin, and Steel [1979]). The original Project Talent participants are now between the ages of approximately 66 to 70.[1] In collaboration with the University of Michigan's Survey Research Center, AIR fielded a pilot mail survey in 2011-12 (funded by research funds provided by AIR and by NIA grants P30-AG012846-17S1 and U01-AG009740-21S2). The PTPS12 was designed to inform the methodological design and substantive foci of future research on aging using PT data. The PTPS12 sample was created by first randomly subsampling 10% of schools from the original sample, and then randomly selecting 10% of students from within those schools. The total sample size used in this study was 4,879 individuals. For more information on the PTPS12, see Stone et al. (forthcoming).

[1] Because students were enrolled as part of grade cohorts, the majority were age 16 to 19 at the time of the 1960 base year collection. However, ages ranged from 11 to 22.

Measures

Vital Status

Mortality status was determined through multiple modes, including record matching on mortality databases as well as through participant tracking for the Pilot Study and information gathered from Pilot Study survey returns. There were three primary databases used in the record matching: a commercial credit bureau service, the Social Security Administration's Death Master File (DMF), and the National Center for Health Statistics' (NCHS) National Death Index (NDI). PT records were first matched to the commercial credit bureau records, then to the DMF and NDI. The records were matched using a combination of Social Security number (SSN), subject's name, and date of birth. All records were matched against the commercial database and the DMF. A subset of all records were matched to the NDI; any records with a known date of death (e.g., those identified as deceased in the commercial database or the DMF) outside the date range available in the NDI (1979 to 2008 at the date of last matching) were not sent to NCHS for matching to the NDI. All other records were included in the records sent to NCHS. The DMF does not cover all deaths (Hill & Rosenwaike, 2001), and the NDI yielded matches not found in the DMF. In addition, deaths were verified while tracking current address information for PTPS12 sample members and in the course of data collection. For more information on PT mortality records matching and PTPS12 procedures, see Stone et al. (forthcoming).

Based on the availability of records in the various databases, vital status was determined as of August 31, 2012 for the purposes of these analyses. Through the results of the mortality records matching and the Pilot Study, vital status was classified as Known Deceased (16%), Known Living (71%), and Unknown (13%) (Stone et al., 2012).

Cause of Death (COD)

While date of death was determined from all possible sources, cause of death was only available from the NDI. The primary cause of death used in these analyses was taken from the NDI "Underlying Cause of Death Code," and was categorized using the Clinical Classifications Software (CCS) developed at the Agency for Healthcare Research and Quality (AHRQ). In order to ensure sufficient analytic power for analyses by cause of death, the deaths were classified as (1) cardiovascular disease (e.g., coronary atherosclerosis and acute myocardial infarction), (2) cancer (e.g., lung cancer and breast cancer), and (3) other deaths (e.g., external causes of injury and poisoning).

Demographic Background

All analyses include controls for demographic factors that have been shown to be related to mortality (Hauser & Palloni, 2010). Five demographic measures were included in these analyses: age in 1960, self-reported socioeconomic status (SES) at adolescence, high school class rank, self-reported health before age10, and minority status.

Age in 1960. Because the base year sample included students enrolled in grades 9-12 in 1960, the majority of participants were between 16 and 19 years of age at the time of the base year data collection. However, approximately 3 percent of the sample were outside this range, with self-reported ages as young as 11 and as old as 22.

Socioeconomic status. SES was created as a composite, consisting of students' self-reports of home value, parent's income, parent's education, parent's occupation, and other items such as the number of books in the home. The composite was created as a standardized score, with a mean of approximately 100, a standard deviation of approximately 10, and a range of 58 to 135.

Class rank. High school class rank, shown by Hauser and Palloni (2011) to be a proxy measure of academic behavior, was created by comparing sample members' self-reported grades (in math, reading, biology, and all courses combined) to the self-reported grades of all students in the same grade in his/her school.[2] This relative ranking was then classified into five quintiles.

Self-reported health. In 1960, students were asked "Which one of the following best describes your usual health before you were ten years old?", with response categories of *very poor*, *poor*, *fair*, *good*, *very good*, and *excellent*. Preliminary research by Stone et al. (2011) and Bradley and Zhang (2012) demonstrated that self-reported general health at adolescence is an important factor in

[2] This measure was created using all Project Talent data, not just the records selected for the Pilot Study. Self-reported grades for each pilot study case were compared to all students within the grade and school, regardless of whether the other cases were included in the Pilot Study.

predicting later mortality. For these analyses, self-reported health was categorized as *poor (very poor and poor)*, *average (fair and good)*, and *excellent (very good and excellent)*.

Minority status. Race and ethnicity were not ascertained in the 1960 base year collection, but were collected in the 5- and 11-year follow-up surveys. As a result, self-reported race/ethnic background was available for only 42% of the cases in these analyses. In cases where self-reported race/ethnicity was not available, the following methods were used to impute a measure of minority status. First, race and ethnicity data were obtained through PTPS12, which were used to classify another 16% of sample members' race/ethnicity status. Among the remaining 42% of sample members, we used school-level information about the racial and ethnic composition of the student population to assign the student's probable minority status. Students enrolled in schools where in 1960 the school administrator reported that at least 70% of students were minorities ("Black," "Oriental," "Indian," and "Other") were categorized as minority. Students who attended a school where the administrator reported that no more than 30% of students were minorities were categorized as non-minority. Students enrolled in schools where the reported minority enrollment was between 31% and 69% were classified as "missing" minority status. This imputation step added yielded an additional 35% of cases with minority status, for a total of 93% of cases with known minority status. The resulting distribution included 80% non-minority students, 13% minority students, and 7% with missing race/ethnicity status.

For more information on these variables, including the construction of derived variables, see Wise, McLaughlin, and Steel (1979).

Cognitive Measures

Cognitive ability was assessed through multiple scales. We conducted exploratory analyses using nine scales that were validated in previous analyses (McArdle, 2010; McPhee, 2010): Vocabulary I (crystallized intelligence); Spatial visualization in 3 dimensions (visualization); Mathematics II (quantitative ability); Clerical checking (speed); Memory for sentences (long-term memory); Memory for words (short-term memory), Abstract reasoning; Arithmetic reasoning (mathematical reasoning); and

Creativity. These scales were created separately for males and females. For a detailed description of the construction of these cognitive measures, see Flanagan et al. (1962). Our exploratory analyses indicated that when considered individually, several cognitive ability scales predicted mortality. When considered simultaneously, five measures–abstract reasoning, spatial visualization in 3 dimensions, memory for sentences, memory for words, and creativity–were consistently related to mortality, and were therefore used in these analyses.

Abstract reasoning is a non-verbal test of abstract inductive reasoning ability. It consists of 15 items and requires that the student view sets of diagrams, determine the logical relationship among elements of the pattern, and apply this relationship to identify the missing element that belongs in each pattern set. *Spatial visualization in 3 dimensions* consists of 16 items that assess the ability to visualize what a two-dimensional figure would look like if it were folded or rolled to form a three-dimensional figure, *Memory for sentences* assesses long-term memory by first providing students with 6 minutes to memorize 40 sentences. After two intervening tests, the students are provided with 16 items that each present one of the sentences with one word missing. The student then must recall the missing word and identify the second letter of the missing word from the list of five response options. *Memory for words* assesses short-term memory by providing students with 2 minutes to study 24 common English words and their "equivalent" in another (created) language, followed shortly thereafter by a series of items where students are required to identify the English equivalent to the foreign word from among the five response options provided for each of the 24 word pairs. The *Creativity* measure is constructed from 20 items and is intended to assess ingenuity and inventive skill. The student reads a description of a problem that contains clues to a possible solution, and is required to devise the solution. The response categories do not merely list possible solutions, but present them using only the first and last letters of the possible answers, thereby forcing the student to develop the answer rather than select it from the list.

Personality Traits

Personality was assessed through ten scales: sociability, social sensitivity, impulsiveness, vigor, calmness, tidiness, culture, leadership, self-confidence, and mature personality. Each scale was constructed from items that consisted of adjectives and behavioral descriptions associated with the specific trait (e.g., "I often lose my temper," or "I seem to know how other people feel about things."), with students indicating the extent to which the statement describes him/herself. All scales were standardized separately for males and females. For a detailed description of these personality traits, see Flanagan et al. (1962). Roberts (2012) mapped the Project Talent personality item-level data to the "Big Five" personality traits (extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience) and found that personality traits measured in Project Talent were reasonably well correlated with the Big Five. Our analyses focused on the five personality scales that were both statistically significant predictors during exploratory bivariate analysis and that had reasonably high correlations with the Big Five: social sensitivity, impulsiveness, vigor, calmness, and self-confidence.

Social sensitivity "involves the ability to put oneself in another's place. The person with social sensitivity is aware of and concerned about the feelings and desires of others." Social sensitivity is strongly positively associated with the Big Five domain of Agreeableness (r=.70) and moderately associated with Conscientiousness (r=.53), and is constructed from 9 items, including "I like to tease people," and "People consider me a sympathetic listener." *Impulsiveness* measures the "tendency to make snap decisions, to act without full consideration, to do and say things on impulse and whim." It is constructed from 9 items, including "I don't believe in rushing into things," and "When I have a problem, I make up my mind and don't worry about it," and is moderately negatively correlated (r=-.42) with the Big Five domain of Conscientiousness. *Vigor* assesses the activity level of a person, primarily physical activity, through 7 items, including "I can work or play outdoors without getting tired," and "I am full of pep and energy." It is moderately positively correlated (r=.59) with the Big Five domain of Extroversion. *Calmness* measures "the ability to react appropriately to emotional situations rather than displaying extremes of elation, temperament, excitability, depression, etc." It is constructed from 9 items, including "I often lose my temper," and "I can usually keep my wits about me even in difficult situations," and is associated with the Big Five domains of Agreeableness (r=.64), Neuroticism (r=-.60), and Conscientiousness (r=.62). *Self-confidence* assesses "a basic personal security manifested in confidence in one's own worth and social acceptability. It implies willingness to proceed on one's own and a certain independence of thought and action." This measure is constructed from 12 items, including "Being around strangers makes me feel ill-at-ease," and "People seem to think I usually do a good job on whatever I'm doing," and is associated with the Big Five domains of Neuroticism (r=-.70), Extraversion (r=.50), and Conscientiousness (r=.48).

Statistical Methods

The major focus of the current study was to investigate whether and to what extent adolescent cognitive ability and personality traits predict mortality across the lifespan after controlling for basic demographic background characteristics. We specified a series of Cox proportional hazard regression models to investigate the relationship among cognitive ability, personality, and mortality. The Cox model predicts the probability that a case will be deceased at time (*t*). For an individual with a vector of explanatory variables $x = (x_1 ... x_k)$, the Cox model defines the hazard for mortality (h) at time (t) as

$$h_i(t) = \lambda_0(t)\exp(\beta_1 x_{i1} + ... + \beta_k x_{ik}).$$

In this equation, the term $\lambda_0(t)$ represents the baseline hazard that may vary over time; it is the hazard for mortality at time *t* when all independent variables' values are equal to zero. The factor $\exp(\beta_1 x_{i1} + ... + \beta_k x_{ik})$ is time independent. $\beta = (\beta_1 ... \beta_k)$ is a vector of regression coefficients reflecting the effects of the vector of explanatory variables on mortality.

In order to examine how the likelihood of mortality risk was affected by demographic, cognitive ability, and personality traits, we specified four models:

(1) $h(t) = \lambda_0(t)\exp(\beta_j Background_j)$

(2) $h(t) = \lambda_0(t)\exp(\beta_j Background_j + \beta_i CognitiveAbility_i)$

(3) $h(t) = \lambda_0(t)\exp(\beta_j Background_j + \beta_k Personality_k)$

(4) $h(t) = \lambda_0(t)\exp(\beta_j Background_j + \beta_i CognitiveAbility_i + \beta_k Personality_k)$

The first model was estimated to approximate the total effects of a vector of *(j)* background information (on mortality. The second model extends the first model by taking into account the effects of a vector of (*i*) cognitive measures to assess how adolescent cognitive ability affects mortality when controlling for demographic background. The third model adds a vector of (*k*) personality measures to model one to investigate whether adolescent personality traits influence mortality. In the fourth model, we incorporate both cognitive ability and personality traits to examine how early life cognitive ability and personality are related to mortality when controlling for demographic background.

The time axis was defined as the number of days between the respondents' 1960 survey date and either the date of death (if deceased) or August 1, 2012 (if censored).

Due to different mortality rates for men and women, as well as our expectation that personality and cognitive ability would operate differently for men and women (Stone et al., 2011; Bradley & Zhang, 2012), we conducted separate analyses for males and females. Further, in order to investigate whether the effects of cognitive ability and personality on mortality risk change over the lifespan, we conducted similar sets of Cox regression models across different life stages. Three life stages were included in the analyses: young adulthood to early mid-life (age 17-49); mid-life (age 50-59); and late mid-life to early old age (age 60-74). [3] Although it would have been preferable to classify cases in more refined categories, sample size considerations restricted the analyses

[3] We understand that the labels assigned to these categories are somewhat imprecise, reflecting the large age ranges needed due to relatively small sample sizes. When a larger number of cases are included into the Project Talent mortality data files, we will refine age groupings to allow for a more nuanced analysis of differences in mortality across the lifespan.

to these relatively broad age ranges. Moreover, due to the relatively small sample sizes for females, the life stage specific analyses were only conducted for males.

To investigate how cognitive ability and personality affect cause-specific mortality, equivalent Cox regression models were conducted for two types of cause-specific mortality: cardiovascular disease and cancer.

Weights

Final weights for the PTPS12 were not available for the current study. In order to capture original PT sampling structure, we applied a model-based adjustment for Cox regression analyses. The primary stratification variables used in selecting the PT schools were type of school (public, parochial, or private) and geographic location. For public schools, two additional stratification variables were used, school size and retention ratio. Therefore, two strata variables including school and geographic stratifications were created to account for sample design characteristics, which were built into Cox regression models.

Results

Descriptive statistics

Mortality rate and sample characteristics

The PT Pilot Study included 4,879 sample members. As of August 1, 2012, 774 sample members were classified as deceased, for an observed mortality rate of 16%. Table 1 displays gender-specific mortality rates by key demographic variables. As expected, males had a higher observed mortality rate (20%) than was observed for females (12%). The mortality rate for race/ethnic minority males was approximately 8% higher than the rate for their non-minority peers. The observed mortality rate increased as class rank decreased; when comparing across SES, mortality was highest among those in the lowest SES quartile; when considering self-reported health, mortality was the lowest among those reporting very good or excellent greatest health prior to age 10. Patterns were generally similar by gender although differences by minority status were not as pronounced for females as was observed among males.

Cause of Death

Table 2 presents frequency distributions of cause of death (COD) by gender. Overall, cancer was the most frequently reported COD in our sample, including 192 cases or 25% of deceased sample members. Cardiovascular-related disease was the second most reported COD, accounted for 126 cases or about 16% of deceased sample members.[4] This table shows a relatively large proportion of observations with no known COD (26%), which reflects the fact that the NDI (the source of all cause of death information) includes

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[4] While cardiovascular-related deaths are the most frequent cause of death in the U.S., this is driven largely by deaths that occur among those 75 years of age or older. In 2009, cancer-related deaths were the primary cause of death for individuals between the ages of 45-74; cancer- and cardiovascular-related deaths each accounted for approximately 25% of deaths between ages 75-84, and cardiovascular-related deaths were the primary cause of death among Americans age 85 and older (Heron, 2012).

only deaths reported between 1979, and at the time of the PT record matching, 2008. Thus, any deaths that occurred prior 1979 or after 2008 had no reported cause of death and were not included in the cause-specific analyses.

Survival analyses

We present results for our survival analyses in three sections. We first present analyses on the effects of personality, cognitive, and demographic factors on all-cause mortality separately by gender. We then consider the effects of personality and cognitive ability on all-cause mortality across different life stages for males, after controlling for demographic background. We conclude with an examination of how personality, cognitive ability, and demographic factors influence cause-specific mortality risk.

Cox proportional hazard regression models for all-cause mortality by gender

Two sets of Cox proportional hazard regression models were conducted to investigate how personality and cognitive ability influence gender specific all-cause mortality after controlling for demographic background. Tables 3 and 4 display results from four hierarchical models for men and women, respectively. Model 1 shows the association between all-cause mortality and demographic controls. Model 2 includes demographic controls and cognitive ability. Model 3 consists of the demographic variables plus five personality variables. Model 4 contains all demographic, cognitive, and personality measures, and allows us to evaluate the net effects of the different factors.

Males

As seen in Model 1 of Table 3, minority status and self-reported health before age 10 were statistically significantly related to all-cause mortality. The hazard ratio for minority males is 1.5, indicating that on average, a racial/ethnic minority student has a 50% greater risk of dying before August 31, 2012 than did his non-minority peers. Individuals who reported very good or excellent health before age 10 had a 29% lower risk of death compared to those who reported average or good health before 10. However, there was no significant difference in mortality risk between males who reported very good or excellent health and those who reported very poor or poor health before 10, which may be due to the relatively small number of PT participants (less than 5%) who reported very poor or poor health prior to age 10. Family socioeconomic status and class rank were not significantly associated with all-cause mortality.

In Model 2, cognitive ability measures were added to the model, and two cognitive variables were marginally associated with mortality risk: abstract reasoning and long-term memory. Self-reported health before age 10 and age in 1960 remained significant predictors for all-cause mortality, with the effect of minority status reduced to marginal statistical significance.

In Model 3, personality measures were added to the demographic measures in Model 1, with adolescent impulsiveness and vigor significantly associated with mortality risk. Higher impulsivity was associated with greater mortality risk, with a one standard deviation increase in impulsiveness associated with a 15% increase in the risk of death by 2012. Vigor was a statistically significant protective factor—a one standard deviation increase was associated with an 18% decrease in mortality risk over the same time period. The effect of demographic factors remained relatively unchanged from the results in Model 1, with younger students, non-minority students, and those who reported excellent health prior to age 10 having lower mortality risk.

In Model 4, which included demographic, cognitive, and personality factors, statistically significant predictors were age at the base year, long-term memory, impulsiveness, and vigor. Higher impulsiveness was associated with a 15% increase in mortality risk. In contrast, higher vigor was associated with lower mortality risk (HR=0.82). Compared to Model 2, long-term memory remained a marginally statistically significant predictor of mortality risk, while abstract reasoning was no longer a statistically significant predictor of mortality risk.

Females

Overall, when examining the effects of demographic characteristics, personality, and cognitive ability on mortality risk for women (see Table 4), there were fewer statistically significant predictors than were observed for males. For example, in Model 1 only base year age and class rank were statistically significant predictors of mortality risk. In Model 2, where cognitive ability measures were added, the model was marginally significant. None of the cognitive abilities were associated with all-cause mortality risk, and age and class rank remained significant predictors.

When considering the effect of personality on mortality for females in Model 3, only calmness showed significant protective effects, decreasing the risk of mortality by 16%, and no other personality variables were associated with mortality risk.

In Model 4, which included demographic, cognitive, and personality factors, the overall model was marginally significant. Calmness showed statistically significant associations with risk of death, after controlling for demographic factors and cognitive ability. A one standard deviation increase in calmness was associated with a 16% reduction in mortality risk. However, any conclusions about the effects of personality and cognitive ability on mortality risk for females must be viewed with caution, due to the marginal level of statistical significance for the model.

Overall, personality factors are a more consistent set of predictors of mortality risk for both males and females. Among men, cognitive factors were only marginally statistically significant predictors of mortality risk, while personality factors were more consistent predictors. Abstract reasoning and long-term memory were marginally statistically significant predictors in the model without cognitive measures, while impulsiveness and vigor predicted mortality risk in the models without cognitive measures. In the final model abstract reasoning was no longer even marginally significant, while impulsiveness and vigor remained statistically significant. Among women, there were no cognitive measures that predicted mortality, while calmness predicted mortality risk, even after controlling for cognitive factors. For both men and women, comparing Models 2 and 3 to Model 4 suggests independent effects of these factors on mortality risk from adolescence in 1960 through 2012. Personality factors that were statistically significant predictors of mortality risk in without controlling for cognitive factors (Model 3) retain their statistical significance in the models where cognitive factors are controlled for (Model 4).

Predictors of male all-cause mortality across the lifespan

To investigate the associations among mortality, cognitive ability, and personality across the lifespan, Cox regression models were applied to three major life stages: young adulthood to early mid-life (17-49), mid-life (50-59), and late mid-life to early old age (60 - 74). Table 5 displays the results of these analyses. In each of the models, the dependent variable was dichotomized such that 0=deceased within specified age range and 1=known living or unknown mortality status, with cases with mortality outside the specified age range excluded from the model. Unlike the results in Tables 3 and 4, the same records were not included in each model, and therefore caution should be exercised when directly comparing the results across models. That said, they can provide preliminary evidence regarding patterns of association between personality and cognitive ability across different stages of the life course, and suggest avenues for further research.

Within young adulthood to early mid-life stage (age 17 to 49), vigor was associated with mortality risk, while calmness was a marginally significant predictor. Males with higher levels of adolescent vigor had decreased risk of mortality before age 50, with a one standard deviation increase in vigor associated with a 26% decrease in mortality risk. In contrast, no cognitive factors were significantly associated with mortality risk.

When examining mid-life mortality (age 50-59), the overall model was not a strong overall predictor of mortality risk (model $p<.10$). Impulsiveness was the only personality variable that significantly predicted the risk of death between ages 50-59, with a one standard deviation increase in impulsiveness resulting in a 26% increase in mortality risk over the 10-year period. Similar to the results observed for the young adulthood stage, no cognitive ability factors had a statistically significant association with mortality risk.

Within late mid-life to early old age (age 60 - 74), the overall model fit was improved. Several factors were associated with mortality risk, including age in 1960, minority status, impulsiveness, and vigor. Older students, racial/ethnic minorities, and students with higher adolescent impulsiveness were all at greater risk of death between age 60 and 74. In contrast, those with higher vigor, as assessed in adolescence, had a decreased risk of mortality over this age span, after controlling for other factors. Similar to the results found for the young to middle adulthood, cognitive ability factors did not significantly predict mortality.

Overall, these models show preliminary support for the hypothesis that personality factors have differential effects on mortality at different stages in the life course, but the same was not found for cognitive factors. While the regression coefficients were not directly compared across models (i.e., we have not tested to determine whether the effect of impulsiveness is different in the three models), the results suggest that further analyses should be conducted to directly evaluate the changing nature of how personality and cognitive factors affect mortality.

Cox proportional hazard regression models for cause-specific mortality

To investigate whether personality and cognitive ability have an effect on cause-specific mortality risk after controlling for demographic background, Cox models were conducted to test two types of cause-specific mortality: cardiovascular and cancer.[5] In each model, the analyses were restricted to a comparison of the specified cause of death (either cardiac or cancer) to known living or unknown vital status cases (e.g., in the model examining cardiac death, deaths by cancer and other causes are excluded). Unlike the preceding analyses, the cause-specific analyses that follow were include models with males and females combined; this was done for two reasons. First, we combined cases in order to maximize sample size; further, we anticipated that the factors affecting specific types of death should operate similarly regardless of gender. Sample sizes were sufficient to examine cause-specific mortality among males, but not for females; therefore we included models restricted to males only. Table 6 presents the results of these analyses.

Cardiovascular mortality

[5] The Cox regression model for all other cause of death mortality was not significant. Therefore, analyses for other cause of death were excluded from the current study.

Table 6 shows the models predicting the effect of demographic, cognitive, and personality variables on cardiac-related death for males and females combined, and for males only. When examining males and females combined, two cognitive factors— abstract reasoning and short-term memory— were statistically significantly associated with decreased cardiovascular mortality risk after controlling for demographic, personality and other cognitive variables; a third factor, creativity, reached marginal statistical significance. A one standard deviation increase in abstract reasoning or short-term recall resulted in a 28% and a 27% decrease in risk of cardiac-related death, respectively. None of the demographic and personality variables predicted cardiovascular disease mortality risk. For the males only model, the model itself, consisting of demographic, cognitive, and personality variables, was not significantly associated with cardiovascular disease mortality, and no personality or cognitive factors predicted risk of cardiovascular death.

Cancer mortality

In Table 6, the model predicting cancer-related deaths for males and females combined showed that along with demographic factors, impulsiveness predicted cancer-related deaths, while long-term recall and calmness were marginally significant. Students who were older, and those with higher impulsiveness in 1960 had a higher risk of cancer-related mortality by 2012. Specifically, a one standard deviation increase in impulsiveness is associated with a 24% increase in cancer mortality risk. For the males-only model, impulsiveness remained as s statistically significant predictor of cancer mortality risk after all other variables were held constant, and vigor emerged as a statistically significant predictor. A one standard deviation increase in impulsiveness led to about a 45% increase in cancer mortality risk, while a similar increase in vigor was associated with a 26% decrease in cancer mortality risk. There was a marginally statistically significant protective effect of short-term memory on cancer mortality risk.

Conclusions and Discussions

The primary purpose of the current study was to determine whether adolescent personality and cognitive ability predict mortality after basic demographic variables were controlled and whether these effects vary across the lifespan. Further, we extended our analyses to cause-specific mortality by examining how adolescent personality and cognitive ability have an impact on cardiovascular disease and cancer mortality risk.

Effects of adolescent personality and cognitive ability on all-cause mortality

Overall, our findings revealed that personality measured at high school significantly predicted all-cause mortality after controlling for demographic background, for both males and females. In contrast, cognitive ability at adolescence showed marginal effects on male all-cause mortality and no significant effects on female mortality.

In addition, our analyses suggest that effects of personality on mortality risk operate through different dimensions of personality traits for men and women. For males, impulsiveness and vigor were significantly associated with all-cause mortality, whereas only calmness was associated with all-cause mortality for females.

These results are consistent with prior research. When comparing the Project Talent personality domains to contemporary personality domains – the Big Five domains of extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience, impulsiveness correlates most highly with conscientiousness, vigor correlates most highly with extraversion, and calmness correlates most highly with neuroticism and agreeableness. Many researchers have shown that conscientiousness is associated with decreased mortality risk (Kern & Friedman, 2008; Weiss & Costa, 2005). Wilson et al. (2004) found that high levels of neuroticism are associated with higher risk of mortality by investigating older Catholic clergy members. In another study, Wilson et al. (2005) analyzed a population-based sample in Chicago and concluded that high levels of extraversion and low levels of neuroticism are related to lower risk of death in old age (Wilson et al., 2005).

Do the effects of personality and cognitive ability on male all-cause mortality change across lifespan?

Our analyses of Cox models across different life stages provided a preliminary view of how personality, cognitive ability, and mortality are associated across the lifespan. Overall, the measures of personality predicted all-cause mortality for males across the lifespan, but different dimensions of personality predicted all-cause mortality at separate life stages. For young adulthood to early mid-life stage (prior to age 50), vigor and calmness were associated with decreased mortality risk. During the mid-life years (age 50-59), higher impulsivity predicted greater mortality risk. For late mid-life and early old age stage (age 60 – 74), impulsiveness remained and vigor reemerged as significant predictors of all-cause mortality. On the other hand, adolescent cognitive ability did not have a significant effect on mortality.

Effects of personality and cognitive ability on cause-specific mortality

In general, there was a significant association between personality and cognitive ability and cause-specific mortality for both males and females combined. Abstract reasoning and short-term memory were significant predictors for cardiovascular disease mortality regardless of gender; additionally impulsiveness and calmness were significantly associated with cancer mortality when analyzing males and females together. Our analyses showed that among males, adolescent personality and cognitive ability are significant predictors of cancer-related mortality risk. Short-term memory and vigor predicted decreased cancer mortality risk, whereas increased impulsiveness was associated with increased cancer mortality risk.

Examining the patterns of findings when examining all-cause mortality overall, all-cause mortality at different life course stages, and cause-specific mortality suggests possible underlying mechanisms at work. For example, cognitive factors were not shown to be consistent predictors of all-cause mortality, but the results from the cause-specific mortality models suggest that depending on the specific cause of death, cognitive factors may play a role. When examining cardiovascular-related deaths, abstract reasoning, short-term memory, and to a lesser extent, creativity, predict mortality risk. We speculate that the emergence of cognitive factors as predictors of cardiovascular mortality risk may reflect a person's ability to engage in everyday activities – such as maintaining a regimen of daily medications – that can prevent or treat conditions such as hypertension or high cholesterol, and in turn reduce the risk of cardiac death. On the other hand, cognitive ability may have a more limited role in enabling and facilitating behaviors related to preventing or treating cancer.

Study Limitations and Areas for Further Research

The results presented here contribute to an increasing body of knowledge on the relationship between personality, cognitive ability, and mortality. However, there are several limitations of our research, cautions regarding generalizing beyond the scope of the current work, and several areas of promising research that merit discussion. First, most demographic data were self-reported, including health before age 10 and family SES. While these self-reports are meaningful, they should not be assumed to be the same as a health assessment, or SES as reported by a parent. Second, race/ethnicity information was not uniformly collected from individuals. Instead, missing race/ethnicity data were imputed by assigning individuals' racial/ethnical status by information about the racial composition of the students' school. Given national demographics and the highly segregated nature of the US educational system in 1960, students were very likely to attend schools where most or all students were either white, non-Hispanic, or were racial/ethnic minorities. However, we know that where misclassification occurred, it tended to under-identify minorities (i.e., race/ethnic minorities were more likely to be a minority group within a predominately non-minority school, rather than the opposite). Beyond issues related to variables included in the models, there are model specification issues that should be addressed. Because the pilot study sample consisted of a random sample of all base year cases, we were not able to leverage followup data to examine the intervening effects, such as SES in adulthood, educational attainment, income, marital status, and other factors shown to be significant predictors of mortality. We are not able to show whether the adolescent personality and cognitive factors in our analyses operate directly on mortality or whether they operate indirectly, influencing factors across the life course that in turn affect mortality risk.

The analyses presented here serve to illustrate the wealth of potential that Project Talent provides for understanding how early life experiences and characteristics affect outcomes across the life course, including the likelihood of death overall and by specific causes. For example, with a larger sample size Project Talent can be used to examine mortality in more detail among women. A unique quality of PT is the wealth of cognitive and personality measures contained in the data and a full examination of the relative effect of these different factors will be greatly enhanced by a larger sample size and increased analytic power. Finally, by continuing to match the PT data to mortality records such as the NDI, we will be able to study cause-specific mortality in increasing detail.

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Table 1. Mortality rates by gender for key demographic variables

	Male		Female	
	n	Percent	n	Percent
Overall	486	20%	288	12%
Race/Ethnicity Status				
Minority	77	26%	51	14%
Nonminority	366	19%	218	11%
Missing	43	27%	19	11%
Class Rank (1960)				
Bottom 20%	123	23%	60	15%
Middle 60%	277	20%	171	12%
Top 20%	65	18%	41	8%
Missing	21	21%	16	23%
Self-reported Health Before Age 10 (1960)				
Very good or Excellent	236	18%	148	10%
Fair or Good	157	23%	89	12%
Very poor or Poor	22	22%	19	15%
Missing	71	24%	32	20%
Family Socioeconomic Status (1960)				
Bottom 20%	119	23%	70	13%
Middle 60%	269	19%	168	11%
Top 20%	83	21%	41	10%
Missing	15	20%	9	19%

Table 2. Frequency distribution of cause of death by gender

Cause of death	Male		Female		All	
	N	%	N	%	N	%
Cardiovascular disease	97	20	29	10	126	16
Cancer	101	21	91	32	192	25
Other	162	33	92	32	254	33
No known cause of death	126	26	76	26	202	26
Total	486		288		774	

Table 3. Cox models for all-cause mortality: Males only

	Model 1		Model 2		Model 3		Model 4	
Parameters	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio
Demographics								
Age	0.07	1.08	0.07	1.07†	0.08	1.08†	0.07	1.08†
Race/Ethnicity (ref=non-minority)								
Minority	0.40	1.50*	0.29	1.34†	0.35	1.42*	0.25	1.29
Missing	0.76	2.14***	0.67	1.95**	0.71	2.04***	0.63	1.88**
Family SES (ref=Bottom 20%)								
Middle 60%	-0.08	0.92	-0.05	0.95	-0.04	0.96	-0.02	0.98
Top 20%	0.06	1.07	0.17	1.19	0.14	1.15	0.22	1.24
Missing	-0.50	0.60	-0.36	0.70	-0.44	0.65	-0.31	0.73
Health before age 10 (ref=very good/excellent)								
Fair or good	0.26	1.29*	0.23	1.26*	0.17	1.18	0.15	1.17
Very poor or poor	0.17	1.19	0.13	1.14	0.09	1.10	0.04	1.05
Missing	0.31	1.37*	0.22	1.24	0.22	1.25	0.15	1.17
Class Rank (ref=Bottom 20%)								
Middle 60%	-0.16	0.85	-0.11	0.90	-0.11	0.90	-0.06	0.94
Top 20%	-0.23	0.80	-0.15	0.86	-0.12	0.89	-0.06	0.94
Missing	0.01	1.01	-0.02	0.98	0.09	1.09	0.05	1.05
Cognitive ability								
Abstract Reasoning			-0.10	0.90			-0.09	0.92
Spatial in 3 D			0.02	1.02			0.02	1.02
Long-term memory			-0.09	0.91			-0.09	0.91†
Short-term memory			-0.07	0.94			-0.06	0.94
Creativity			-0.04	0.96			-0.03	0.97
Personality								
Social Sensitivity					-0.01	0.99	-0.01	0.99
Impulsiveness					0.14	1.15**	0.14	1.15**
Vigor					-0.20	0.82***	-0.20	0.82***
Calmness					-0.07	0.93	-0.05	0.95
Self Confidence					0.02	1.02	0.03	1.04
-2 log likelihood (df)	3664.22 (12)***		3649.60(17)***		3641.11(17)***		3629.29(22)***	

Table 4. Cox models for all-cause mortality: Females only

	Model 1		Model 2		Model 3		Model 4	
Parameters	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio
Demographics								
Age	0.11	1.12*	0.11	1.12*	0.12	1.13*	0.12	1.12*
Race/Ethnicity (ref=non-minority)								
Minority	0.23	1.25	0.15	1.16	0.25	1.28	0.17	1.19
Missing	0.13	1.14	0.07	1.07	0.12	1.12	0.05	1.05
Family SES (ref=Bottom SES Quintile)								
Middle 60%	0.00	1.00	0.04	1.04	0.02	1.02	0.05	1.05
Top 20%	0.07	1.07	0.15	1.16	0.11	1.11	0.17	1.19
Missing	-0.50	0.60	-0.48	0.62	-0.39	0.68	-0.37	0.69
Health before age 10 (ref=very good/excellent)								
Fair or Good	0.09	1.09	0.08	1.09	0.05	1.05	0.05	1.05
Very poor or poor	0.34	1.41	0.34	1.41	0.28	1.32	0.29	1.34
Missing	0.33	1.39	0.28	1.32	0.24	1.28	0.20	1.22
Class Rank (ref=Bottom 20%)								
Middle 60%	-0.23	0.79	-0.18	0.83	-0.21	0.81	-0.17	0.85
Top 20%	-0.63	0.53**	-0.52	0.59*	-0.59	0.56**	-0.49	0.61*
Missing	0.31	1.37	0.35	1.42	0.29	1.33	0.32	1.37
Cognitive ability								
Abstract Reasoning			-0.07	0.93			-0.07	0.93
Spatial in 3 D			0.03	1.03			0.03	1.03
Long-term memory			-0.07	0.93			-0.07	0.93
Short-term memory			0.03	1.03			0.02	1.02
Creativity			-0.08	0.93			-0.07	0.93
Personality								
Social Sensitivity					0.10	1.10	0.11	1.11
Impulsiveness					-0.05	0.96	-0.05	0.95
Vigor					-0.05	0.95	-0.06	0.95
Calmness					-0.17	0.84*	-0.17	0.84*
Self Confidence					0.04	1.04	0.04	1.05
-2 log likelihood (df)	2349.79 (12)*		2345.71(17)†		2343.70(17)*		2339.85(22)†	
Change in -2 log likelihood from Model 1			4.08		6.09		9.94	
n	2389		2389		2389		2389	

*** Significant at 0.001 level. ** Significant at 0.01 level. * Significant at 0.05 level. † Significant at 0.10 level.

Note: all models include school and geographic stratification variables to account for sample design characteristics

Table 5. Cox models for all-cause mortality across lifespan : males only

	Age 17-49		Age 50-59		Age 60 and older	
Parameters	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio
Demographics						
Age	0.01	1.01	0.03	1.03	0.14	1.15*
Race/Ethnicity (ref=non-minority)						
Minority	0.46	1.59	-0.01	0.10	0.44	1.56†
Missing	0.72	2.05	0.38	1.46	0.90	2.45***
Family SES (ref=Bottom 20%)						
Middle 60%	0.05	1.05	0.00	1.00	-0.15	0.86
Top 20%	0.52	1.68	0.06	1.06	0.15	1.16
Missing	-1.05	0.35	-0.02	0.98	-0.47	0.63
Health before age 10 (ref=very good/excellent)						
Fair or Good	0.38	1.47	0.18	1.20	0.09	1.10
Very poor or poor	0.29	1.34	-0.30	0.74	0.15	1.16
Missing	0.15	1.16	0.32	1.38	0.10	1.10
Class Rank (ref=Bottom 20%)						
Middle 60%	-0.18	0.83	-0.16	0.85	-0.06	0.94
Top 20%	-0.02	0.98	0.01	1.01	-0.20	0.82
Missing	0.05	1.05	0.20	1.23	-0.31	0.73
Cognitive ability						
Abstract Reasoning	-0.07	0.93	-0.10	0.91	-0.12	0.88
Spatial in 3 D	-0.08	0.93	0.06	1.07	0.04	1.04
Long-term memory	-0.09	0.91	-0.13	0.88	-0.09	0.91
Short-term memory	0.03	1.04	-0.06	0.95	-0.14	0.87
Creativity	0.00	1.00	-0.13	0.87	0.03	1.03
Personality						
Social Sensitivity	0.09	1.10	-0.02	0.98	0.00	1.00
Impulsiveness	0.05	1.06	0.23	1.26**	0.15	1.16*
Vigor	-0.31	0.74**	-0.17	0.85	-0.23	0.79**
Calmness	-0.26	0.78†	0.01	1.01	-0.01	0.99
Self Confidence	0.00	1.01	-0.03	0.97	0.04	1.04
-2 log likelihood (df)	870.45(22)*		1267.15(22)†		1563.45(22)***	

Table 6. Cox models for cause-specific mortality

	Cardiovascular				Cancer			
	All		Males		All		Males	
Parameters	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio
Demographics								
Age	0.07	1.07	-0.05	0.95	0.12	1.13†	0.05	1.05
Race/Ethnicity (ref=non-minority)								
Minority	0.33	1.39	0.04	1.05	0.61	1.85*	0.39	1.48
Missing	0.27	1.32	0.38	1.46	0.69	1.99*	1.09	2.98*
Family SES (ref=Bottom 20%)								
Middle 60%	-0.14	0.87	-0.02	0.98	-0.03	0.97	-0.22	0.80
Top 20%	-0.02	0.98	0.08	1.08	0.15	1.16	0.35	1.42
Missing	0.02	1.03	0.38	1.46	-0.19	0.83	-0.19	0.83
Health before age 10 (ref=very good/excellent)								
Fair or Good	-0.02	0.99	0.14	1.15	0.19	1.21	0.08	1.08
Very poor or poor	0.06	1.06	0.36	1.43	0.48	1.61	0.43	1.54
Missing	-0.07	0.94	-0.08	0.93	-0.11	0.89	-0.34	0.71
Class Rank (ref=Bottom 20%)								
Middle 60%	0.13	1.14	0.23	1.26	-0.14	0.87	-0.12	0.88
Top 20%	-0.33	0.72	-0.20	0.82	-0.32	0.73	-0.03	0.97
Missing	0.16	1.17	-0.11	0.89	0.34	1.41	0.16	1.17
Cognitive ability								
Abstract Reasoning	-0.33	0.72**	-0.24	0.79	-0.01	0.99	-0.10	0.91
Spatial in 3 D	0.15	1.16	0.00	1.01	0.06	1.06	0.08	1.09
Long-term memory	-0.15	0.86	-0.14	0.87	-0.14	0.87†	-0.10	0.90
Short-term memory	-0.32	0.73**	-0.10	0.90	-0.05	0.95	-0.24	0.79†
Creativity	0.20	1.23	0.08	1.08	-0.09	0.92	-0.18	0.84
Personality								
Social Sensitivity	-0.03	0.97	0.15	1.16	0.09	1.09	-0.01	0.99
Impulsiveness	-0.10	0.91	-0.03	0.97	0.21	1.24**	0.37	1.45***
Vigor	-0.05	0.95	-0.15	0.86	-0.14	0.87	-0.30	0.74*
Calmness	-0.04	0.96	-0.18	0.84	-0.17	0.84†	-0.04	0.96
Self Confidence	-0.07	0.93	-0.01	0.99	-0.01	0.99	0.07	1.07
-2 log likelihood (df)	1057.26(22)**		685.84 (22)		1710.61(22)**		713.30(22)**	