Published in final edited form as:

Soc Sci Med. 2015 November ; 144: 69–78. doi:10.1016/j.socscimed.2015.09.011.

Psychological and Cognitive Determinants of Mortality: Evidence from a Nationally Representative Sample Followed over Thirty-five Years

Amelia Karraker¹, Robert F. Schoeni², and Jennifer C. Cornman³

¹Human Development and Family Studies, Iowa State University

²Institute for Social Research, Ford School of Public Policy, and Department of Economics,
University of Michigan

³Jennifer C. Cornman Consulting

Abstract

Growing evidence suggests that psychological factors, such as conscientiousness and anger, as well as cognitive ability are related to mortality. Less is known about 1) the relative importance of each of these factors in predicting mortality, 2) through what social, economic, and behavioral mechanisms these factors influence mortality, and 3) how these processes unfold over long periods of time in nationally-representative samples. We use 35 years (1972–2007) of data from men (ages 20–40) in the Panel Study of Income Dynamics (PSID), a nationally representative sample in the United States, and discrete time event history analysis ($n=27,373$ person-years) to examine the importance of measures of follow-through (a dimension of conscientiousness), anger, and cognitive ability in predicting mortality. We also assess the extent to which income, marriage, and smoking explain the relationship between psychological and cognitive factors with mortality. We find that while follow-through, anger, and cognitive ability are all associated with subsequent mortality when modeled separately, when they are modeled together and baseline demographic characteristics are controlled, only anger remains associated with mortality: being in the top quartile for anger is associated with a 1.57 fold increase in the risk of dying at follow-up compared with those in the bottom quartile. This relationship is robust to the inclusion of income, marriage, and smoking as mediators.

Keywords

personality; cognitive ability; mortality; marriage; socioeconomic status; United States

Studies find that conscientiousness (e.g., Roberts et al., 2007), anger (e.g., Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002), and cognitive ability (e.g., Deary, Weiss, & Batty, 2010)

Please address correspondence to Dr. Amelia Karraker, Department of Human Development and Family Studies, Iowa State University, 4380 Palmer, Suite 1331, Ames, IA, 50011. (karraker@iastate.edu).

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

are all associated with health and ultimately mortality. Less work, however, has considered these factors together as independent risk factors for mortality, though emerging evidence suggests important connections between personality, emotional regulation, and cognitive function (Wilkowski & Robinson, 2008), which may in turn have implications for health and mortality. Further, much of the work that has examined psychological and cognitive determinants of health and mortality has used non-representative samples (Campbell et al., 2014; Friedman et al., 1995; Terraciano et al., 2008), short observational windows (Hill et al., 2011; Weiss & Costa, 2005), or both, leaving unanswered questions regarding the generalizability of how these psychological and cognitive factors unfold across the life course to impact mortality.

An additional unanswered question is through what social, economic, and behavioral processes psychological and cognitive factors are associated with health and mortality. Prior research has identified psychological and cognitive factors as important determinants for outcomes such as family formation, wages, and risky behaviors (Heckman, Stixrud, & Urzua, 2006), and these factors are also all strongly linked to health and mortality (Herd, Goesling, & House, 2007; Lantz et al., 1998; Waite, 1995). Most data sources with measures of both psychological and cognitive factors and health and/or mortality observe individuals from childhood or adolescence through early middle age, precluding an examination of the role of factors such as income, marriage, or smoking behavior at mid-life as mechanisms linking psychological and cognitive factors and mortality, which is rare before middle age. While datasets that focus on older age groups benefit from observing the period of the life course where mortality is common, these data may be subject to mortality selection prior to the study. Furthermore, socioeconomic processes unfold most importantly during, roughly, ages 20–55, and these experiences may not be fully captured in studies of older adults.

We address these gaps in the literature on psychological and cognitive determinants of mortality by using 35 years of data from the nationally-representative Panel Study of Income Dynamics (PSID) to examine the relationship between follow-through (an important dimension of conscientiousness), anger, and cognitive ability in 1972 and mortality through 2007. Our analytic sample consists of males who are no older than age 40 in 1968. This age range enables us to examine how follow-through, anger, and cognitive ability shape mortality via life course social processes related to income and marital status and smoking. We ask three questions. First, how are follow-through, anger, and cognitive ability related to mortality when modeled separately? Second, how are follow-through, anger, and cognitive ability related to mortality when modeled together? Third, what role do income, marriage, and smoking behavior play in explaining possible links between follow-through, anger, and cognitive ability with mortality? We also account for the connections between socioeconomic status and follow-through, anger, and cognitive ability. Individuals with greater follow-through and cognitive ability, and lower anger, may be more likely to continue in school, which in turn may facilitate further gains in psychological and cognitive skills (Mirowsky & Ross, 2007). And higher levels of financial resources may in fact enhance follow-through (Pearlin, Nguyen, Schieman, & Milkie, 2007). By accounting for the relationships between socioeconomic status and psychological and cognitive factors, we reduce bias in our estimates of these factors.

Conscientiousness, Health, and Mortality

A large literature has examined the relationship between personality characteristics and health. Many of these studies focus on dimensions of the Big Five (Costa & McCrae, 1992), which includes openness, conscientiousness, extraversion, agreeableness, and neuroticism. Among the most consistent findings from these studies is the positive association between conscientiousness and health (Goodwin & Friedman, 2006; Reiss, Eccles, & Nielsen, 2014). Conscientiousness contains several facets, including orderliness, industriousness, persistence, self-control, and responsibility (Roberts et al., 2014). Individuals who report higher levels of conscientiousness are less likely to report a variety of physical and mental health conditions (Goodwin & Friedman, 2006), disease progression (O’Cleirigh, Ironson, Weiss, & Costa, 2007), and are more likely to live longer lives (Friedman et al., 1995; Hill et al., 2011). Among the dimensions of conscientiousness, a meta-analysis has found that those related to achievement, such as persistence—which is quite similar to follow-through, and those related to order including organization and discipline were most-strongly related to longevity (Kern & Friedman, 2008).

Why is conscientiousness associated with health and mortality? Broadly speaking, facets of conscientiousness, such as organization, hard work, tenacity, impulse control, dependability, and conformity with norms and rules facilitate successful navigation of many dimensions of life (Bogg & Roberts, 2004), such as continued engagement with social roles related to employment and family and reduced involvement in deviant behaviors. More specifically, conscientiousness is associated with a variety of social and behavioral factors—health behaviors, socioeconomic status, and marriage—that are themselves associated with better health (Herd et al., 2007; Lantz et al., 1998; Waite, 1995).

Much of the work that has examined conscientiousness and health has focused on health behaviors. Individuals with higher levels of conscientiousness are less likely to engage in a variety of unhealthy behaviors, including tobacco use, substance abuse, risky driving and sexual practices, violent behavior, and physical inactivity (for a summary, see Bogg & Roberts, 2004). Prior work has also identified the importance of psychological factors such as conscientiousness for labor market outcomes, including employment and wages (e.g., Farkas, 2003). Research has also found that social responsibility—a component of conscientiousness—is negatively associated with divorce in early midlife (Roberts & Bogg, 2004) and positively associated with positive marital interaction (Robins, Caspi, & Moffitt, 2000). To date, however, the relative importance of various social factors—especially income and marital status—as mechanisms linking conscientiousness and health has not been extensively tested using nationally representative data with a long observational window.

Anger, Health, and Mortality

Several studies have demonstrated a link between anger and health. Anger is an emotional state that ranges from mild irritation to fury or rage and has been associated with health and all-cause mortality (Suinn, 2001; Wilkowski & Robinson, 2008). A major focus of research on the anger–health connection has been coronary heart disease, where the weight of the

evidence indicates important harmful impacts of anger (Chida & Steptoe, 2009; Smith, Glazer, Ruiz, & Gallo, 2004). For example, anger is associated with atherosclerosis (Harris, Matthews, Sutton-Tyrrell, & Kuller, 2003), endothelial dysfunction (Gottdiener et al., 2003), and heart attack (Nawrot et al., 2011).

Anger has also been linked to a number of health behaviors associated with health and mortality. Elevated anger or hostility is associated with tobacco use and excess alcohol consumption (Bunde & Suls, 2006), high body mass index (Bunde & Suls, 2006), poor eating habits and reduced aerobic physical activity (Anton & Miller, 2005), disrupted sleep following interpersonal conflict (Brissette & Cohen, 2002), and aggressive driving behavior (Deffenbacher, Deffenbacher, Lynch, & Richards, 2003). Less work, however, has examined the extent to which anger may impact health via economic outcomes and social relationships. Indirect evidence which links anger to workplace aggression (Douglas & Martinko, 2001) suggests that angry individuals may have difficulty with labor force attachment and promotion, potentially resulting in reduced wages and unemployment. In addition, anger compromises social relationships, including marriage (Wilkowski & Robinson, 2008). Anger is negatively associated with current and future marital adjustment (Baron et al., 2007) as well as prospective marital separation and divorce (Miller, Markides, Chiriboga, & Ray, 1995). As such, anger, like conscientiousness, may affect individuals' ability to fulfill economic and social roles. While these studies are intriguing, they are based on convenience or not nationally-representative samples and thus may not be generalizable to the whole population.

Cognitive Ability, Health, and Mortality

Cognitive ability, or intelligence, is also associated with health and mortality (Deary et al., 2010). Cognitive ability reflects "at a minimum, verbal, reading, and writing abilities, as well as those in mathematics, science, music, and art" and is often measured using aptitude tests (Farkas, 2003: 543). Those with higher cognitive ability are less likely to suffer from a variety of mental illnesses, dementia, accidental injury, physical illnesses—including cardiovascular disease and cancer—experience lower all-cause, disease-specific mortality, and death from homicide (for a review, see Deary et al., 2010).

As with conscientiousness and anger, cognitive ability may be associated with mortality through its association with facilitating or impeding individuals' successful navigation of the social world. For example, individuals with higher cognitive ability may be better able to process information about their health, leading to healthier behaviors (Cutler & Llearas-Muney, 2010). Indeed, cognitive ability is associated with a variety of health behaviors, including lower likelihood of smoking (Weiser et al., 2010). Studies have also documented economic returns to cognitive ability (Farkas, 2003; Heckman et al., 2006), though there is some (but not conclusive) evidence that psychological skills are more important (Bowles & Gintis, 2002). Finally, theory suggests that intelligence should be positively associated with marriage (Becker, 1973), in part through its favorable association with economic outcomes. Actual studies linking cognitive ability and marriage, however, are rare. One study of a Scottish birth cohort born in 1921 found that IQ at age 11 was positively associated with

ever-marriage among men, but was negatively associated with ever-marriage among women (Taylor et al., 2005).

Considering Psychological and Cognitive Factors Together

Emerging evidence suggests that psychological factors such as conscientiousness and anger are intertwined with cognitive ability. For example, in their study of Wisconsin High School graduates, Hauser and Palloni (2011) find that while adolescent IQ is negatively associated with mortality by age 68, this association is completely mediated by high school academic performance. Doing well in school, the authors argue, not only requires intelligence, but also “responsible, compliant behavior, of consistently doing the right thing in the right way at the right time and place”—behaviors that are aligned with conscientiousness (Hauser & Palloni, 2011: i98). Further, psychological factors such as motivation influence how individuals perform on cognitive tests, and facets of personality also include cognitive processes (Borghans, Duckworth, Heckman, & Ter Weel, 2008: 1035). In addition, emerging work in cognitive psychology and neuroscience provides further motivation for the connections between emotional and psychological factors with cognition within the brain (Blair, 2002; Ochsner & Gross, 2005). For example, cognitive processes influence how individuals interpret their surroundings and thus influence their subsequent emotional reactions to these conditions (Wilkowski & Robinson, 2008). Thus, a failure to consider these factors jointly obscures the true relative importance of specific psychological and cognitive determinants of mortality. In short, if critical psychological and cognitive factors are not controlled, estimates of both may be biased.

Data and Methods

Sample

Data come from the Panel Study of Income Dynamics (PSID). Started in 1968 with a representative sample of 18,230 individuals in 4,802 families, the PSID is the longest running household panel study in the United States. Data have been collected every year from 1968 to 1997 and every two years thereafter. The sampling design results in a representative sample of families in the US. Reinterview response rates have been around 98% per year, or about 96% over 2 years. Differential probabilities of selection due to sample design and attrition are accounted for using weights provided by the PSID.

Analyses focus on 1,307 males who were household heads interviewed in every wave between 1968 and 1972 and no older than age 40 in 1968. We limit the sample in this manner for a number of reasons. First, data on two of our main variables of interest (follow-through and anger) are only collected from 1968 to 1972 and only for household heads. PSID convention is to assign headship in married-couple families to males; therefore, male household heads are a representative sample of adult males, but female household heads are not a representative sample of adult females. Second, the measures of anger and follow-through are averaged across all reports between 1968 and 1972 to increase reliability, as described below. Third, the sample is restricted to individuals age 40 years old and younger because very few people die by age 40 and, as described in the introduction, important changes in social and economic processes that occur in middle age can be assessed, while

minimizing concerns of mortality selection. While an age range of 20–40 captures those both in early and middle adulthood, our baseline analytic sample includes these ages in order to have sufficient sample size to detect meaningful effects of key independent variables. We control for baseline age to account for cohort effects and differential selection.

Measures

Follow-through—The measure of conscientiousness used here is a score based on three variables that assess whether respondents tend to follow-through with plans. For each variable, respondents choose one of two statements that best describes themselves. One point is assigned for each variable in which the respondent endorses the statement indicating a tendency to follow-through:

1. Are you the kind of person that plans his life ahead all the time (1 point) or do you live more from day to day (0 points)?
2. When you make plans ahead, do you usually get to carry out things the way you expected (1 point), or do things usually come up to make you change your plans (0 points)?
3. Would you say you nearly always finish things once you start them (1 point), or do you sometimes have to give up before they are finished (0 points)?

Each of these questions is asked in survey years 1968–1972. To increase the reliability of the overall follow-through score, we first take the 5-year average for each item, where the average is based on the number of valid responses, and sum the three averages, resulting in a follow-through score that ranges from 0–3. The alpha for the follow-through score based on the 5-year averages is 0.71 compared with 0.47 for a score based on the variables measured only in 1972.

Anger—Anger is measured by a single item indicating whether respondents report that they “get angry fairly easily” vs. “it taking a lot to get them angry”. Anger is measured every year from 1968–1972, so we assign one point for endorsing the easily angered option and calculate the 5-year average, based on the number of valid responses, resulting in a measure that ranges from 0 to 1. Anger can be conceptualized as a “transitory state or a stable and general disposition to experience this emotion” with those higher in trait anger being more likely to experience state anger (Miller et al. 1996: 322). As such, our measure more likely captures trait anger rather than only transitory state anger.

Cognitive Ability—Cognitive ability is created from a sentence completion task.

Interviewers read aloud a series of 13 sentences, which respondents could also see written in a booklet, with each sentence missing a word. Respondents are asked to choose and read aloud a word from a list of four words provided in the booklet that makes the best, truest, most sensible complete sentence. Each correct answer is given one point and the number of points is totaled across all items.

We also conducted preliminary analysis to ascertain the correlations between these factors as well as to explore additional psychological factors that could be gleaned from the 1968–1972 psychological battery. Correlations between our three key independent variables are

weak to moderate ($|r|=0.07\text{--}0.34$), suggesting that these factors are distinct but also should be simultaneously controlled in order to reduce bias in estimates. We also examined other factors as determinants of mortality—namely, future-orientation—but we opted to omit this factor because it did not have a statistically significant relationship with mortality

Confounder Variables—All analyses control for a number of baseline (1972) characteristics that could potentially confound the relationship between follow-through, anger, and cognitive ability and mortality and that are independent predictors of mortality. Controls include *age* (an interval level variable), *marital status* (married vs. not married), *race* (White vs. non-White), *education* (less than high school, high school, more than high school), and *total family income* (year-specific quartiles) adjusted for inflation and family size. We also control for whether the respondent reports a *physical or nervous condition* that limits the type of work or the amount of work the respondent could do. Finally, we include one baseline health behavior measure—a proxy for *exposure to smoking*. Beyond its strong association with mortality, prior literature has linked psychological and cognitive factors with smoking. PSID did not collect information on individual smoking behavior in 1972. As a proxy for exposure to smoking, we control, at baseline, for whether the respondent lives in a household that spent any money on cigarettes in the previous year. In mediation analyses, that include post-baseline measures, described further below, we also include time-varying age to account for the non-linear relationship between age and mortality.

Mediators—We focus on three covariates—marriage, income, and smoking—that prior work has linked to health and mortality that also may be linked to follow-through, anger, and cognitive ability and thus might constitute explanatory mechanisms mediating the relationship between psychological and cognitive factors and mortality. First, *time-varying marital status* at each wave is an indication of whether respondents are married vs. not married. While there is important variation in the health impacts of being unmarried depending on whether one is never married, widowed, or divorced, we limit our analysis to differences between being married vs. not married because prior research shows that the most-striking difference in mortality is between the currently married and non-married (e.g., Waite, 1995) and due to sample size constraints. Second, we examine the mediating effects of *time-varying annual family income* (year-specific quartiles) adjusted for inflation and family size. Our third mediator is *1986 smoking status* (1=current, 0=former, never smoker)—the first year in which PSID ascertained individuals' smoking status.

Survival/Response Status

All PSID sample members are followed over time. At each wave, a respondent is classified as in the sample, dead, or lost-to-follow-up. When a respondent dies, they are permanently exited from the study and our analysis. Respondents who are lost-to-follow-up at one wave but successfully complete an interview at a later wave are allowed to exit and re-enter our analysis. Overall, there are 355 deaths among the 1,307 male household heads in our study. We are unable to analyze 93 of these deaths because they follow a period of being lost-to-follow-up and are, therefore, missing information on the time-varying mediators. At the end of our study period, 2007, 445 respondents remained active members of the sample (e.g. were neither lost-to-follow-up nor dead).

Statistical Analysis

Table 2 considers the relationships between psychological and cognitive factors, baseline confounders, and mortality. First, to mirror previous analyses of follow-through, anger, cognitive ability and mortality, we estimate a series of discrete time hazard models that control for baseline age and race and examine, in separate models, the effects of follow-through, anger, and cognition on mortality and attrition. Second, we examine how these variables are related when modeled together, initially controlling only for baseline race and age and then controlling for the remaining baseline control variables to determine the relationships between our main predictors of interest and survival/attrition net of potential confounding variables.

Table 3 adds mediators to the full model presented in Table 2 in order to understand the economic and social pathways that link psychological and cognitive factors with mortality. Table 3 focuses on income and marriage as mediators. We estimate a series of three models all of which include the full set of baseline characteristics. The first model adds time-varying age and marital status. The second adds time-varying age and income. The third model adds all three time-varying factors.

Finally, Table 4 considers smoking behavior as an additional mediator. Because individual smoking behavior was not ascertained until 1986, the analytic sample for the analysis presented in Table 4 is a subset of our sample that had neither died, been permanently lost to attrition, nor had missing information on 1986 smoking status. The first model includes psychological and cognitive factors, baseline age, and race. Model 2 adds all other baseline covariates. Model 3 adds all mediators (income, marriage, 1986 smoking status) and time-varying age. To determine whether the relationship between follow-through, anger or cognition and mortality is mediated by time-varying marital status or income, or 1986 smoking status, we assess whether the inclusion of the mediators reduces the magnitude and/or significance of the coefficients for follow-through, anger and cognitive ability.

All results presented come from discrete time multinomial logistic regression models estimated using Stata 11.2 (StataCorp, 2012). The results (expressed as relative risk ratios) represent the risk of either dying or becoming lost-to-follow-up relative to surviving.

Results

Table 1 displays summary statistics for the analytic sample at baseline. The average age in 1972 is 34.5 years, and the vast majority are married (90.5%) and White (86.9%). Twenty-eight percent have less than a high school degree, 24% are high school graduates, and 48% have more than a high school degree. Median baseline family income (adjusted for family size) is \$35,100 (in 2007 dollars) and about 59% live in a household with cigarette expenditures. Mean cognitive ability is 10.0 (range 0–13), mean follow-through is 2.2 (range 0–3), and, on average, respondents report angering easily 20 percent of the time (i.e. one out of five years) between 1968–72.

Table 2 displays results from multinomial logistic regression predicting mortality and attrition compared with survival through 2007 controlling for baseline age and race. When

modeling follow-through, anger, and cognitive ability separately, those in the top quartile for follow-through have lower mortality (Model 1, RRR=0.618), and those in the top quartile for anger have higher mortality (Model 2, RRR=1.702) compared with those in the respective bottom quartiles. In substantive terms, those in the top anger quartile answered “I get angry easily in the affirmative two or more times between 1968 and 1972, compared with zero times for the bottom quartile. Higher cognitive ability scores are also associated with a lower risk of mortality (Model 3, RRR=0.499). However, when follow-through, anger, and cognitive ability are modeled together, the relationship between follow-through and mortality is attenuated and loses statistical significance (Model 4). Anger and cognitive ability remain significant predictors of mortality and the relative risk ratio of each of these two factors changes only modestly when all three factors are included simultaneously. When controls for additional baseline characteristics are added, only anger remains a significant predictor of mortality and the magnitude of the coefficient for anger is only reduced modestly (Model 5, RRR=1.565). In supplemental analyses (not shown), we find that controlling for education leads to the loss of significance of the relationship between cognitive ability and mortality. Further, supplementary analyses show that it is a combination of both anger and cognitive ability that leads to the relationship between follow-through and mortality becoming insignificant. Neither anger nor cognitive ability alone has an impact on the follow-through-mortality relationship. Psychological and cognitive factors also predict attrition. Those in the third and fourth quartiles for follow-through are less likely to attrit compared with those in the lowest quartile, while those in the second quartile for anger are more likely to attrit compared with those in the bottom quartile in the full model (Model 5).

Several baseline characteristics (Model 5) are significantly associated with mortality across models. Older respondents and those who lived with a smoker are at higher risk of dying, while married (versus unmarried) respondents and respondents with more than a high school education (vs, those with less than a high school education) are less likely to die. Income is also negatively associated with mortality, and although the only significant difference is between respondents in the second vs. first quartile of family income, we fail to reject the null hypothesis of equality of coefficients between quartiles two through four in either Table 2 or Table 3 (not shown), suggesting that the impact of income on mortality is concentrated at the bottom of the income distribution. The relative risk ratios imply that mortality is much lower for Whites, and higher for those with a work-limiting health condition, but the coefficients are not precisely estimated.

Table 3 displays results that include time-varying mediators (marital status and family income) as well as time-varying age, follow-through, anger, cognitive ability, and baseline social, economic, and demographic characteristics. Table 2 showed that among follow-through, anger, and cognition, only anger was independently associated with mortality in the full model. As such, we are particularly interested in whether this anger-mortality relationship is changed by the inclusion of time-varying covariates. We see, however, that the relationship between anger and mortality is changed little by the inclusion of these variables. Those in the top quartile for anger are more likely to die versus survive even after accounting for time-varying age, marriage, and income, and the relative risk ratio changes very little: 1.565 in Table 2, Model 5 versus 1.660 in Table 3, Model 3. These time-varying

factors are also associated with mortality. Time-varying age is positively related to mortality, while time-varying marital status (married or not) and income are negatively associated with mortality.

In the mediation analysis that also considers smoking (Table 4), the positive relationship between the top quartile for anger and mortality is very similar to the relationships presented in Tables 2 and 3 and similar in models that exclude 1986 smoking (Model 1; Q4 Anger RRR=1.821; $p=0.005$) and include 1986 smoking (Model 2; Q4 Anger RRR=1.566, $p=0.045$), though it is reduced to only marginal statistical significance when all other time-varying covariates (age, marital status, and family income) are included (Model 3; Q4 Anger RRR=1.560; $p=0.053$).

Discussion

Using a nationally-representative, prospective study of American male heads of households, we examined the relative importance of follow-through, anger, and cognitive ability on mortality over 35 years. We find that while measures of follow-through, anger, and cognitive ability are all strongly associated with mortality when modeled separately, only anger is independently associated with mortality when all of these factors are modeled together and baseline factors are controlled. This relationship is robust to the inclusion of mediators including income, marriage, and smoking.

Why are those who anger easily more likely to die? Prior work has linked anger with a variety of negative physiological processes, including atherosclerosis (Harris, Matthews, Sutton-Tyrrell, & Kuller, 2003) and endothelial dysfunction (Gottdiener et al., 2003), which can lead to serious and potentially fatal health events such as heart attack (Nawrot et al., 2011). This suggests that the actual embodiment of trait anger in physiological processes may be responsible for the observed association between anger and mortality. A direct physiological pathway between anger and mortality would help explain why the observed relationship is robust to the inclusion of mediators. However, it is also possible that the inclusion of a more-complete set of health behaviors (not available until 1999 in the PSID) would have explained more of the relationship between anger and mortality.

We also identified other factors as independent predictors of mortality. Consistent with many prior studies (e.g., Dowd et al., 2011; Lleras-Muney, 2005; Waite, 1995), we found that marriage, education, and income are all negatively associated with mortality, while tobacco exposure is positively associated with mortality (e.g., Mokdad, Marks, Stroup, & Gerberding, 2004). In our examination of 1986 smoking as a mediator (conditional on survival to 1986), we found that the anger-mortality relationship was reduced to marginal significance once 1986 smoking status was controlled. However, that the point estimate for anger remained nearly unchanged suggests that the reduction in statistical significance reflects a loss of power rather than smoking mediating the anger-mortality relationship.

Few studies on the impact of psychological and cognitive factors on mortality account for selective attrition. We find that individuals with higher follow-through are less likely to attrit and individuals high in anger are more likely to attrit from the survey, though accounting for

attrition does not alter the substantive conclusions regarding the effects of conscientiousness, anger, and cognitive ability, future studies using other samples should account for attrition to make sure that conclusions are not driven by these patterns.

Given that psychological and cognitive factors may “work together” to impact mortality, we conducted additional analysis in which we interacted follow-through with cognitive ability to test whether the effect of follow-through is concentrated among individuals with high cognitive ability. We did not find support for this hypothesis (results not shown). In addition, we did not find statistically significant interactions between either cognitive ability and anger or follow-through and anger.

Our study also has some limitations. First, our measures of follow-through and anger predate the establishment of now widely-used measures such as the Big Five personality inventory. This makes it difficult to directly compare our measures with those used by other studies. In addition, our psychological measure responses are dichotomous “yes”/“no” responses—which restricts response variability compared with a Likert scale. Further, PSID did not administer IQ tests, thus our measure of cognitive ability is limited compared with other studies of cognitive ability and health—especially in terms of capturing the full range of cognitive ability in the population. However, our lack of the Big Five and other measures is offset by the opportunity to study repeated measures of follow-through—one of the most important dimensions of conscientiousness—and of anger in conjunction with cognitive ability over 35 years. In addition, the survey did not collect cognitive and psychological measures for a representative sample of women in 1968–1972. As such, we did not examine psychological and cognitive predictors of mortality among women. Because women have lower mortality risk than men, and on average are more likely to exhibit high levels of conscientiousness and better emotional control (though not cognitive ability), results may differ for women (Duckworth & Seligman, 2006). An additional limitation is that our analytic sample is comprised of those who are healthiest (i.e. survive to be in the study), resulting in some left-censoring. However, because mortality is quite rare before age 40, left-censoring likely biases results little.

Finally, research suggests the importance of early life experiences—especially related to parental income and education—for the formation of psychological and cognitive factors. Given that our sample is nationally-representative of adult men and did not ask detailed retrospective questions about childhood experiences or socioeconomic circumstances, our paper cannot examine their role in psychological and cognitive development. In particular, educational experiences likely play a large role in the development of these factors. Our psychological and cognitive measures are first collected in 1968–1972, when most of our respondents have completed all or at least the majority of their education. Psychological factors both influence schooling decisions (Heckman et al., 2006) and may be fostered by additional schooling. However, we do not find that adjustment for completed years of education is the reason why follow-through does not significantly influence mortality; instead, it is the simultaneous adjustment for anger and cognitive ability that causes follow-through to become insignificant.

Despite its limitations, our study documents the importance of considering both cognitive and psychological factors in addition to income and marriage as determinants of mortality in a nationally-representative sample of men followed over 35 years. We show the importance of modeling these factors together, as follow-through, anger, and cognitive ability are all associated with mortality when modeled separately, but only anger is independently associated with mortality when all factors are modeled jointly and baseline factors are controlled. We also find that the anger-mortality relationship is robust to income, marriage, and smoking, as well as to attrition. That we see a robust relationship between anger and subsequent mortality over 35 years highlights the importance of psychological factors in mortality across the middle and later life course.

Acknowledgments

The authors gratefully acknowledge use of the services and facilities of the Population Studies Center at the University of Michigan, funded by NICHD Center Grant R24 HD041028. This study was also supported by a National Institute on Aging training grant to the Population Studies Center at the University of Michigan (T32 AG000221). This research also received funding from the Michigan Center on the Demography of Aging at the University of Michigan, which is sponsored by the National Institute on Aging, Centers on the Demography and Economics of Aging (P30 AG012846).

References

- Anton SD, Miller PM. Do Negative Emotions Predict Alcohol Consumption, Saturated Fat Intake, and Physical Activity in Older Adults? Behavior modification. 2005; 29(4):677–688. [PubMed: 15911688]
- Baron K, Smith T, Butner J, Nealey-Moore J, Hawkins M, Uchino B. Hostility, Anger, and Marital Adjustment: Concurrent and Prospective Associations with Psychosocial Vulnerability. Journal of Behavioral Medicine. 2007; 30(1):1–10. [PubMed: 17165122]
- Becker GS. A Theory of Marriage: Part I. Journal of Political Economy. 1973; 81(4):813–846.
- Blair C. School readiness: Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. American Psychologist. 2002; 57(2):111–127. [PubMed: 11899554]
- Bogg T, Roberts BW. Conscientiousness and Health-Related Behaviors: A Meta-Analysis of the Leading Behavioral Contributors to Mortality. Psychological Bulletin. 2004; 130(6):887–919. [PubMed: 15535742]
- Borghans L, Duckworth AL, Heckman JJ, Weel Bt. The Economics and Psychology of Personality Traits. Journal of Human Resources. 2008; 43(4):972–1059.
- Bowles S, Gintis H. Schooling in Capitalist America Revisited. Sociology of Education. 2002; 75(1): 1–18.
- Brisette I, Cohen S. The Contribution of Individual Differences in Hostility to the Associations between Daily Interpersonal Conflict, Affect, and Sleep. Personality and Social Psychology Bulletin. 2002; 28(9):1265–1274.
- Bunde J, Suls J. A quantitative analysis of the relationship between the Cook-Medley Hostility Scale and traditional coronary artery disease risk factors. Health Psychology. 2006; 25(4):493–500. [PubMed: 16846324]
- Campbell F, Conti G, Heckman JJ, Moon SH, Pinto R, Pungello E, et al. Early Childhood Investments Substantially Boost Adult Health. Science. 2014; 343(6178):1478–1485. [PubMed: 24675955]
- Chida Y, Steptoe A. The Association of Anger and Hostility with Future Coronary Heart Disease: A Meta-Analytic Review of Prospective Evidence. Journal of the American College of Cardiology. 2009; 53(11):936–946. [PubMed: 19281923]
- Costa PT, McCrae RR. Normal personality assessment in clinical practice: The NEO Personality Inventory. Psychological Assessment. 1992; 4(1):5–13.

- Cutler DM, Lleras-Muney A. Understanding differences in health behaviors by education. *Journal of Health Economics*. 2010; 29(1):1–28. [PubMed: 19963292]
- Deary IJ, Weiss A, Batty GD. Intelligence and Personality as Predictors of Illness and Death: How Researchers in Differential Psychology and Chronic Disease Epidemiology Are Collaborating to Understand and Address Health Inequalities. *Psychological Science in the Public Interest*. 2010; 11(2):53–79. [PubMed: 26168413]
- Deffenbacher JL, Deffenbacher DM, Lynch RS, Richards TL. Anger, aggression, and risky behavior: a comparison of high and low anger drivers. *Behaviour Research and Therapy*. 2003; 41(6):701–718. [PubMed: 12732377]
- Douglas SC, Martinko MJ. Exploring the role of individual differences in the prediction of workplace aggression. *Journal of Applied Psychology*. 2001; 86(4):547–559. [PubMed: 11519640]
- Dowd JB, Albright J, Raghunathan TE, Schoeni RF, LeClere F, Kaplan GA. Deeper and wider: income and mortality in the USA over three decades. *International Journal of Epidemiology*. 2011; 40(1):183–188. [PubMed: 20980249]
- Duckworth AL, Seligman MEP. Self-discipline gives girls the edge: Gender in self-discipline, grades, and achievement test scores. *Journal of Educational Psychology*. 2006; 98(1):198–208.
- Farkas G. Cognitive Skills and Noncognitive Traits and Behaviors in Stratification Processes. *Annual Review of Sociology*. 2003; 29:541–562.
- Friedman HS, Tucker JS, Schwartz JE, Martin LR, Tomlinson-Keasey C, Wingard DL, Criqui MH. Childhood conscientiousness and longevity: health behaviors and cause of death. *Journal of personality and social psychology*. 1995; 68(4):696–703. [PubMed: 7738772]
- Goodwin RD, Friedman HS. Health Status and the Five-factor Personality Traits in a Nationally Representative Sample. *Journal of Health Psychology*. 2006; 11(5):643–654. [PubMed: 16908463]
- Gottdiener JS, Kop WJ, Hausner E, McCeney MK, Herrington D, Krantz DS. Effects of mental stress on flow-mediated brachial arterial dilation and influence of behavioral factors and hypercholesterolemia in subjects without cardiovascular disease. *The American Journal of Cardiology*. 2003; 92(6):687–691. [PubMed: 12972107]
- Harris KF, Matthews KA, Sutton-Tyrrell K, Kuller LH. Associations Between Psychological Traits and Endothelial Function in Postmenopausal Women. *Psychosomatic Medicine*. 2003; 65(3):402–409. [PubMed: 12764213]
- Hauser RM, Palloni A. Adolescent IQ and Survival in the Wisconsin Longitudinal Study. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*. 2011; 66B(suppl 1):i91–i101.
- Heckman, James J.; Stixrud, J.; Urzua, S. The Effects of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behavior. *Journal of Labor Economics*. 2006; 24(3):411–482.
- Herd P, Goesling B, House JS. Socioeconomic Position and Health: The Differential Effects of Education versus Income on the Onset versus Progression of Health Problems. *Journal of health and social behavior*. 2007; 48(3):223–238. [PubMed: 17982865]
- Hill PL, Turiano NA, Hurd MD, Mroczek DK, Roberts BW. Conscientiousness and longevity: An examination of possible mediators. *Health Psychology*. 2011; 30(5):536–541. [PubMed: 21604882]
- Kern ML, Friedman HS. Do conscientious individuals live longer? A quantitative review. *Health Psychology*. 2008; 27(5):505–512. [PubMed: 18823176]
- Kiecolt-Glaser JK, McGuire L, Robles TF, Glaser R. Emotions, morbidity, and mortality: new perspectives from psychoneuroimmunology. *Annual Review of Psychology*. 2002; 53(1):83–107.
- Lantz PM, House JS, Lepkowski JM, Williams DR, Mero RP, Chen J. Socioeconomic factors, health behaviors, and mortality: Results from a nationally representative prospective study of us adults. *JAMA*. 1998; 279(21):1703–1708. [PubMed: 9624022]
- Lleras-Muney A. The Relationship between Education and Adult Mortality in the United States. *The Review of Economic Studies*. 2005; 72(1):189–221.
- Miller TQ, Markides KS, Chiriboga DA, Ray LA. A Test of the Psychosocial Vulnerability and Health Behavior Models of Hostility: Results From an 11-Year Follow-Up Study of Mexican Americans. *Psychosomatic Medicine*. 1995; 57(6):572–581. [PubMed: 8600484]

- Mirowsky J, Ross CE. Trajectories of perceived control and their relationship to education. *American Journal of Sociology*. 2007; 112(5):1339–1382.
- Mokdad AH, Marks JS, Stroup DF, Gerberding JL. Actual causes of death in the United States, 2000. *JAMA*. 2004; 291(10):1238–1245. [PubMed: 15010446]
- Nawrot TS, Perez L, Künzli N, Munters E, Nemery B. Public health importance of triggers of myocardial infarction: a comparative risk assessment. *The Lancet*. 2011; 377(9767):732–740.
- Ochsner KN, Gross JJ. The cognitive control of emotion. *Trends in Cognitive Sciences*. 2005; 9(5): 242–249. [PubMed: 15866151]
- O’Cleirigh C, Ironson G, Weiss A, Costa PT Jr. Conscientiousness predicts disease progression (CD4 number and viral load) in people living with HIV. *Health Psychology*. 2007; 26(4):473–480. [PubMed: 17605567]
- Pearlin LI, Nguyen KB, Schieman S, Milkie MA. The Life-Course Origins of Mastery among Older People. *Journal of health and social behavior*. 2007; 48(2):164–179. [PubMed: 17583272]
- Reiss D, Eccles JS, Nielsen L. Conscientiousness and public health: Synthesizing current research to promote healthy aging. *Developmental Psychology*. 2014; 50(5):1303–1314. [PubMed: 24773105]
- Roberts BW, Bogg T. A Longitudinal Study of the Relationships Between Conscientiousness and the Social-Environmental Factors and Substance-Use Behaviors That Influence Health. *Journal of Personality*. 2004; 72(2):325–354. [PubMed: 15016067]
- Roberts BW, Kuncel NR, Shiner R, Caspi A, Goldberg LR. The Power of Personality: The Comparative Validity of Personality Traits, Socioeconomic Status, and Cognitive Ability for Predicting Important Life Outcomes. *Perspectives on Psychological Science*. 2007; 2(4):313–345. [PubMed: 26151971]
- Roberts BW, Lejuez C, Krueger RF, Richards JM, Hill PL. What is conscientiousness and how can it be assessed? *Developmental Psychology*. 2014; 50(5):1315–1330. [PubMed: 23276130]
- Robins RW, Caspi A, Moffitt TE. Two personalities, one relationship: Both partners’ personality traits shape the quality of their relationship. *Journal of Personality and Social Psychology*. 2000; 79(2): 251–259. [PubMed: 10948978]
- Smith TW, Glazer K, Ruiz JM, Gallo LC. Hostility, Anger, Aggressiveness, and Coronary Heart Disease: An Interpersonal Perspective on Personality, Emotion, and Health. *Journal of Personality*. 2004; 72(6):1217–1270. [PubMed: 15509282]
- Suinn RM. The terrible twos—anger and anxiety: Hazardous to your health. *American Psychologist*. 2001; 56(1):27–36. [PubMed: 11242985]
- StataCorp. Stata Statistical Software: Release 11.2. College Station, TX: StataCorp LP; 2012.
- Sutin AR, Terracciano A, Deiana B, Naitza S, Ferrucci L, Uda M, et al. High Neuroticism and low Conscientiousness are associated with interleukin-6. *Psychological Medicine*. 2010; 40(9):1485–1493. [PubMed: 19995479]
- Taylor MD, Hart CL, Smith GD, Whalley LJ, Hole DJ, Wilson V, et al. Childhood IQ and marriage by mid-life: the Scottish Mental Survey 1932 and the Midspan studies. *Personality and Individual Differences*. 2005; 38(7):1621–1630.
- Waite LJ. Does Marriage Matter? *Demography*. 1995; 32(4):483–507. [PubMed: 8925942]
- Weiss A, Costa PT Jr. Domain and facet personality predictors of all-cause mortality among Medicare patients aged 65 to 100. *Psychosomatic medicine*. 2005; 67(5):724–733. [PubMed: 16204430]
- Weiser M, Zarka S, Werbeloff N, Kravitz E, Lubin G. Cognitive test scores in male adolescent cigarette smokers compared to non-smokers: a population-based study. *Addiction*. 2010; 105(2): 358–363. [PubMed: 19919595]
- Wilkowski BM, Robinson MD. The Cognitive Basis of Trait Anger and Reactive Aggression: An Integrative Analysis. *Personality and Social Psychology Review*. 2008; 12(1):3–21. [PubMed: 18453470]

Highlights

1. Considers follow-through, anger, and cognitive ability as factors in mortality.
2. Anger is positively associated with mortality independent of other key factors.
3. This relationship is robust to income, marriage, and smoking as mediators.

Table 1

Baseline (1972) Sample Characteristics (n=1307 heads of households)

	Weighted Percent/Mean (sd)
Socio-demographic characteristics (1972)	
Age (range 18–46)	34.5 (6.8)
Married (vs. not)	90.5
White (vs. non-White)	86.9
Education	
Less than high school	28.4
High school	24.0
More than high school	47.6
Has a condition that limits amount or type of work	9.6
Median Family income (000s) ¹	35.1 (22.9)
Lived in a smoking household (e.g. household with a cigarette expenditure	58.5
Cognitive ability (mean score; range 0–13)	10.0 (2.1)
Follows through scale (0–3) ²	2.2 (0.7)
Angers easily (0–1) ³	0.2 (0.3)

n=1307 respondents

¹ Adjusted for inflation and family size, given in 2007 dollars² Sum of 1968–72 average of three dichotomous variables: sure life will work out, usually carries out plans, and finishes things start³ 1968–1972 average of whether respondent gets angry easily

Table 2

Effects (relative risk ratios) of Discrete Time Multinomial Logistic Regression of Follow-through, Anger, and Cognitive Ability on Survival and Being Lost-to-Follow-up, Controlling for Baseline Characteristics

	Model 1			Model 2			Model 3			Model 4			Model 5		
	Died	LFU		Died	LFU		Died	LFU		Died	LFU		Died	LFU	
Follow through (Quartile 1 omitted)															
Quartile 2	0.867 (0.181)	0.825 (0.101)								1.02 (0.222)	0.836 (0.104)		1.147 (0.253)	0.881 (0.111)	
Quartile 3	0.893 (0.201)	0.619** (0.091)								1.17 (0.268)	0.631** (0.096)		1.386 (0.326)	0.697* (0.109)	
Quartile 4	0.618* (0.142)	0.579** (0.081)								0.808 (0.194)	0.599** (0.087)		1.185 (0.296)	0.692* (0.106)	
Anger (Quartile 1 omitted)															
Quartile 2			1.306 (0.269)	1.499** (0.179)						1.259 (0.262)	1.416** (0.170)		1.238 (0.258)	1.408** (0.169)	
Quartile 3			1.469+ (0.325)	1.274+ (0.180)						1.494+ (0.328)	1.142 (0.165)		1.354 (0.303)	1.117 (0.165)	
Quartile 4			1.702** (0.315)	1.176 (0.145)						1.654** (0.315)	1.085 (0.135)		1.565* (0.302)	1.103 (0.137)	
Cognitive Ability (Quartile 1 omitted)															
Quartile 2						0.674* (0.127)	0.868 (0.107)			0.717+ (0.138)	0.942 (0.119)		0.844 (0.168)	1.021 (0.129)	
Quartile 3						0.547** (0.126)	0.794 (0.119)			0.565* (0.132)	0.908 (0.139)		0.749 (0.182)	1.021 (0.158)	
Quartile 4						0.499** (0.119)	0.934 (0.133)			0.525** (0.128)	1.075 (0.159)		0.795 (0.211)	1.272 (0.198)	
Age 1972	1.068** (0.014)	0.977** (0.007)	1.067** (0.014)	0.976** (0.007)		1.066** (0.014)	0.975** (0.007)	1.068** (0.014)	0.978** (0.007)	1.071** (0.015)	0.980** (0.007)		0.775 (0.165)	0.566** (0.070)	
White (vs. non-White)	0.701+ (0.141)	0.541** (0.064)	0.627* (0.119)	0.458** (0.050)		0.732 (0.145)	0.477** (0.055)	0.753 (0.156)	0.538** (0.065)						
1972 Baseline Characteristics															
Married															
Has a condition that limits work															
Education (less than high school omitted)															
High school															
More than high school															
Weighted family income quartiles adjusted for family Size and inflation (Quartile 1 omitted)															
Quartile 2															
Quartile 3															

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Died	LFU	Died	LFU	Died	LFU	Died	LFU	Died	LFU
Quartile 4										
Lived in smoking household									0.695 (0.166)	0.822 (0.124)
									1.855 ^{***} (0.323)	1.004 (0.100)

N = 27, 373 person years

Standard errors in parentheses

^{***} p<0.01,

^{*} p<0.05,

⁺ p<0.1

Table 3

Discrete Time Multinomial Logistic Regression of Mediating Effects (Relative Risk Ratios) of Time-Varying Age, Marital Status, and Income on Survival Being Lost-to-Follow-up, Controlling for Baseline Characteristics

	Model 1			Model 2			Model 3		
	Died	LFU		Died	LFU		Died	LFU	
Follow through (Quartile 1 omitted)									
Quartile 2	1.027 (0.241)	0.872 (0.110)		1.087 (0.252)	0.884 (0.112)		1.033 (0.240)	0.877 (0.111)	
Quartile 3	1.316 (0.322)	0.694* (0.109)		1.32 (0.320)	0.702* (0.110)		1.331 (0.325)	0.705* (0.110)	
Quartile 4	1.189 (0.316)	0.696* (0.108)		1.196 (0.315)	0.699* (0.108)		1.207 (0.318)	0.704* (0.108)	
Anger (Quartile 1 omitted)									
Quartile 2	1.351 (0.285)	1.428** (0.172)		1.329 (0.280)	1.420** (0.171)		1.336 (0.282)	1.417** (0.170)	
Quartile 3	1.432 (0.326)	1.135 (0.168)		1.402 (0.319)	1.13 (0.168)		1.432 (0.326)	1.137 (0.169)	
Quartile 4	1.686** (0.332)	1.118 (0.140)		1.684** (0.332)	1.113 (0.139)		1.660* (0.329)	1.112 (0.139)	
Cognitive Ability (Quartile 1 omitted)									
Quartile 2	0.771 (0.155)	1.001 (0.126)		0.783 (0.156)	1.003 (0.127)		0.773 (0.155)	1.004 (0.127)	
Quartile 3	0.673 (0.167)	1.002 (0.155)		0.689 (0.170)	1.017 (0.158)		0.68 (0.170)	1.013 (0.157)	
Quartile 4	0.745 (0.201)	1.253 (0.197)		0.77 (0.207)	1.287 (0.201)		0.751 (0.201)	1.274 (0.200)	
Age 1972	0.962* (0.015)	0.953** (0.008)		0.956** (0.015)	0.951** (0.008)		0.960** (0.015)	0.952** (0.009)	
White (vs. non-White)	0.679+ (0.152)	0.556** (0.070)		0.671+ (0.147)	0.554** (0.069)		0.694 (0.154)	0.563** (0.071)	
1972 Baseline Characteristics									
Married	0.654 (0.185)	0.680* (0.113)		0.525* (0.138)	0.629** (0.097)		0.676 (0.191)	0.691* (0.114)	
Has a condition that limits work	1.079 (0.256)	0.736+ (0.123)		1.13 (0.266)	0.742+ (0.123)		1.074 (0.253)	0.729+ (0.122)	
Education (less than high school omitted)									
High school	0.816 (0.167)	0.702** (0.093)		0.835 (0.172)	0.718* (0.097)		0.833 (0.172)	0.716* (0.097)	
More than high school	0.468** (0.103)	0.678** (0.087)		0.529** (0.116)	0.721* (0.095)		0.517** (0.113)	0.716* (0.095)	
Weighted family income quartiles adjusted for family size and inflation (Quartile 1 omitted)									
Quartile 2	0.594* (0.122)	1.069 (0.129)		0.618* (0.129)	1.11 (0.138)		0.612* (0.127)	1.109 (0.138)	
Quartile 3	0.815 (0.184)	0.957 (0.132)		0.881 (0.201)	1.029 (0.146)		0.882 (0.202)	1.026 (0.146)	
Quartile 4	0.598* (0.147)	0.806 (0.122)		0.702 (0.182)	0.921 (0.151)		0.706 (0.181)	0.92 (0.150)	

	Model 1		Model 2		Model 3	
	Died	LFU	Died	LFU	Died	LFU
Lived in smoking household	1.891 ^{***} (0.334)	1.005 (0.101)	1.952 ^{***} (0.344)	1.019 (0.102)	1.886 ^{***} (0.332)	1.006 (0.101)
Time varying covariates						
Age	1.124 ^{***} (0.011)	1.030 ^{**} (0.005)	1.123 ^{***} (0.011)	1.031 ^{***} (0.005)	1.121 ^{***} (0.011)	1.030 ^{***} (0.005)
Married (vs. not married)	0.552 ^{***} (0.107)	0.811 (0.107)			0.570 ^{***} (0.110)	0.817 (0.108)
Weighted family income quartiles adjusted for family Size and inflation (Quartile 1 omitted)						
Quartile 2			0.817 (0.158)	0.886 (0.113)	0.853 (0.165)	0.897 (0.114)
Quartile 3			0.792 (0.182)	0.83 (0.113)	0.827 (0.190)	0.837 (0.114)
Quartile 4			0.524 ⁺ (0.147)	0.704 ⁺ (0.117)	0.554 ⁺ (0.154)	0.709 ⁺ (0.117)

N = 27, 373 person years

Standard errors in parentheses

^{***} p<0.01,

^{*} p<0.05,

⁺ p<0.1

Table 4

Discrete Time Multinomial Logistic Regression of Effects (relative risk ratios) of Follow-through, Anger, and Cognitive Ability on Survival and Being Lost-to-Follow-up, Controlling for Baseline Characteristics, Smoking Status in 1986, and Time Varying Covariates

	Model 1		Model 2		Model 3	
	Died	LFU	Died	LFU	Died	LFU
Follow through (Q1 omitted)						
Q2	1.230 (0.327)	0.726 ⁺ (0.133)	1.310 (0.361)	0.750 (0.137)	1.165 (0.330)	0.758 (0.137)
Q3	1.422 (0.393)	0.464 ^{**} (0.100)	1.625 ⁺ (0.464)	0.506 ^{**} (0.110)	1.578 (0.459)	0.521 ^{**} (0.114)
Q4	0.922 (0.270)	0.445 ^{**} (0.095)	1.367 (0.422)	0.487 ^{**} (0.107)	1.350 (0.422)	0.493 ^{**} (0.108)
Anger						
Q2	1.414 (0.333)	1.704 ^{**} (0.287)	1.346 (0.320)	1.693 ^{**} (0.284)	1.421 (0.343)	1.692 ^{**} (0.284)
Q3	1.434 (0.373)	1.303 (0.272)	1.325 (0.352)	1.24 (0.264)	1.356 (0.366)	1.261 (0.270)
Q4	1.821 ^{**} (0.388)	1.316 (0.234)	1.566 [*] (0.350)	1.426 [*] (0.245)	1.560 ⁺ (0.358)	1.422 [*] (0.246)
IQ score						
Q2	0.728 (0.165)	1.157 (0.223)	0.823 (0.196)	1.233 (0.235)	0.810 (0.194)	1.247 (0.240)
Q3	0.561 [*] (0.153)	1.195 (0.269)	0.792 (0.231)	1.252 (0.286)	0.739 (0.222)	1.271 (0.293)
Q4	0.520 [*] (0.149)	1.445 ⁺ (0.313)	0.851 (0.274)	1.605 [*] (0.358)	0.796 (0.259)	1.669 [*] (0.377)
Age 1972	1.083 ^{**} (0.016)	0.977 [*] (0.011)	1.101 ^{**} (0.018)	0.979 ⁺ (0.011)	0.965 (0.022)	0.941 ^{**} (0.014)
White	0.694 (0.178)	0.914 (0.175)	0.643 ⁺ (0.170)	0.997 (0.199)	0.640 (0.176)	1.014 (0.204)
1972 Baseline Characteristics						
Married			0.729 (0.256)	0.682 (0.162)	0.956 (0.348)	0.701 (0.169)
Condition that limits work			0.791 (0.253)	0.818 (0.206)	0.791 (0.254)	0.795 (0.204)
Education (less than high school omitted)						
High school			1.036 (0.249)	0.680 ⁺ (0.135)	1.038 (0.255)	0.698 ⁺ (0.140)
More than high school			0.557 [*] (0.141)	0.895 (0.162)	0.594 [*] (0.156)	0.991 (0.184)
Weighted Family Income Quartiles Adj. for Family Size and Inflation						
Q2			0.599 [*] (0.142)	1.282 (0.217)	0.557 [*] (0.135)	1.32 (0.229)
Q3			0.727 (0.188)	0.768 (0.161)	0.716 (0.193)	0.821 (0.176)
Q4			0.600 ⁺ (0.167)	0.757 (0.164)	0.599 ⁺ (0.176)	0.885 (0.202)

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

	Model 1		Model 2		Model 3	
	Died	LFU	Died	LFU	Died	LFU
Lived in HH that smoked 1972			1.237 (0.274)	1.224 (0.197)	1.222 (0.274)	1.245 (0.200)
Current smoker 1986			2.144** (0.449)	0.78 (0.134)	2.301** (0.507)	0.754 (0.130)
Time varying covariates						
Age					1.149** (0.019)	1.036** (0.012)
Married					0.560** (0.121)	0.984 (0.182)
Weighted Family Income Quartiles Adj. for Family Size and Inflation						
Q2					0.894 (0.199)	0.846 (0.149)
Q3					0.773 (0.211)	0.755 (0.143)
Q4					0.663 (0.212)	0.534** (0.122)

N = 11,380 person years

Standard errors in parentheses

** p<0.01,

* p<0.05,

+ p<0.1