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Translating Personality Psychology to Help Personalize Preventive Medicine for Young-Adult Patients

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Abstract

The rising number of newly insured young adults brought on by healthcare reform will soon increase demands on primary-care physicians. Physicians will face more young-adult patients which presents an opportunity for more prevention-oriented care. In the current study, we evaluated whether brief observer reports of young adults' personality traits could predict which individuals would be at greater risk for poor health as they entered midlife. Following the Dunedin Study cohort of 1,000 individuals, we show that very brief measures of young adults' personalities predicted their midlife physical health across multiple domains (metabolic abnormalities, cardiorespiratory fitness, pulmonary function, periodontal disease, and systemic inflammation). Individuals scoring low on the traits of Conscientiousness and Openness-to-Experience went on to develop poorer health even after accounting for preexisting differences in education, socioeconomic status, smoking, obesity, self-reported health, medical conditions, and family medical history. Moreover, personality ratings from peer informants who knew participants well, and from a nurse and receptionist who had just met participants for the first time, predicted health decline from young adulthood to midlife despite striking differences in level of acquaintance. Personality effect sizes were on par with other well-established health-risk factors such as socioeconomic status, smoking, and self-reported health. We discuss the potential utility of personality measurement to function as an inexpensive and accessible tool for healthcare professionals to personalize preventive medicine. Adding personality information to existing healthcare electronic infrastructures could also advance personality theory by generating opportunities to examine how personality processes influence doctor-patient communication, health service use, and patient outcomes.

Introduction

While most of the clinical burden of age-related diseases (e.g. cardiovascular disease, type II diabetes, hypertension) occurs after midlife, it is now well-established that the

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pathophysiology of these diseases begins earlier in life and accumulates across the life course (Weintraub et al., 2011). Accordingly, health professionals are placing increased emphasis on targeting younger populations for disease prevention (Kavey, Simons-Morton, & de Jesus, 2011; McGill Jr & McMahan, 2003). Various algorithm-based models (e.g. Framingham Risk Score, Systematic Coronary Risk Evaluation, Reynolds Risk Score) are available to facilitate health-risk stratification (see (Berger, Jordan, Lloyd-Jones, & Blumenthal, 2010) for an overview), but these have limited efficacy in patients younger than 30 years (Berry, Lloyd-Jones, Garside, & Greenland, 2007), in part because medical-based tests in young adults do not provide clear clinical direction. Consequently, primary-care practitioners use complementary approaches such as medical-record reviews, family histories of disease, and patient surveys of lifestyle habits (e.g. diet, smoking) to forecast an individual patient's potential health-risk. In this study, we examined whether brief observer reports of personality administered in young adulthood were able to improve prediction of people's health at midlife.

Why use personality traits to predict health?

The rise in the number of newly-insured young adults brought on by healthcare reform will increase demands on the healthcare system (Sommers & Kronick, 2012). Primary-care physicians will face more patients whose needs are unfamiliar to them. A vision for orienting healthcare to better meet patients' needs has been set forth in a recent report by the Institute of Medicine (M. Smith, Saunders, Stuckhardt, & McGinnis, 2013). The report calls for greater patient-centeredness in the healthcare system, stressing the benefit of attending to patients' preferences, values, and characteristic patterns of feeling, thinking, and behaving; in short, their personality (Funder, 1997; John, Robins, & Pervin, 2010; Roberts, 2009). How can health-care practitioners get to know their patients? Personality traits can be measured cheaply, easily and reliably, are stable over many years, and have far-ranging effects on important life outcomes, including morbidity and early mortality. The magnitude of personality effects are on par with other well-established factors such as IQ and socioeconomic status (Deary, Weiss, & Batty, 2011; Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007).

Although earlier research has shown that personality traits predict health and disease (Booth-Kewley & Friedman, 1987), this earlier research used a bewildering variety of approaches to define personality. The resulting proliferation of assessment tools and piecemeal research made it difficult for clinicians to know what personality measures to use, or how to use them. The past two decades have led to a consensus among psychologists that personality differences can be organized along five broad dimensions – Extraversion, Agreeableness, Neuroticism, Conscientiousness, and Openness-to-Experience (with the useful acronym, OCEAN)(John & Srivastava, 1999). These so-called "Big Five" personality traits provide structure for framing previous findings (Digman, 1990; Marshall, Wortman, Vickers, Kusulas, & Hervig, 1994; McCrae & John, 1992; T. W. Smith, 2006; T. W. Smith & Williams, 1992) and guiding translation to clinical practice. Table 1 describes typical high and low scorers for each personality trait.

The most compelling evidence for the contribution of personality to health comes from longitudinal studies showing that Conscientious people live longer (Hill, Turiano, Hurd, Mroczek, & Roberts, 2011; Kern & Friedman, 2008). Numerous studies also lend support to the involvement of Extraversion, Agreeableness, and Neuroticism in health processes (Chapman, Roberts, & Duberstein, 2011; Sutin, Ferrucci, Zonderman, & Terracciano, 2011; Sutin et al., 2010). Less is known about Openness-to-Experience, although here too there is suggestive evidence (Ferguson & Bibby, 2012; Turiano, Spiro, & Mroczek, 2012).

Moving from prediction to theory, and from theory to translation

Research has begun dissecting the personality processes underlying the Big Five factors in order to better understand the mechanisms by which personality 'gets outside the skin' to affect morbidity and mortality (Hampson, 2012). Personality differences are theorized to affect health in several ways: First, personality differences may reflect underlying variation in biological systems linked to the pathogenesis of disease. Neuroticism, characterized by heightened emotional reactivity to environmental stimuli, has been tied to greater activation of neuroendocrine and immune systems (Lahey, 2009). Greater levels of Neuroticism could possibly reflect an underlying hyperresponsiveness to both emotional and physiological negative stimuli. Second, personality differences are thought to relate to the various ways in which people react to illness. This includes the variety of processes in which people cope with stress, seek medical care, adhere to treatment, and engage with others to receive support. For example, individuals higher in Extraversion may seek out more socially engaging environments allowing them to call upon a richer network of social support when dealing with illness (Carver & Connor-Smith, 2010). Third, personality differences are thought to be related to a wide range of health behaviors that either promote or mitigate disease. For example, individuals higher in Conscientiousness are more likely to live active lifestyles, have healthy diets, and refrain from smoking and excessive alcohol consumption (Bogg & Roberts, 2004). These processes – disease pathogenesis, reaction to illness, and health behaviors – are not mutually exclusive and may work together to affect health outcomes.

An upcoming special issue in *Developmental Psychology* highlights the pressing need for implementation science to support personality-health research (Chapman, Hampson, & Clarkin, in press; Israel & Moffitt, in press). To move forward in applying personality measurement in clinical settings requires the utmost confidence in the robustness of personality-health associations. One approach to examining robustness is meta-analysis; a recent report examining personality and all-cause mortality in seven cohorts and over 75,000 adults found that Conscientiousness was consistently associated with elevated mortality risk (Jokela et al., 2013). While these results are certainly impressive, robust prediction should apply not only to a finding's consistency across *studies* but also to its consistency across measurement *sources*. As an analogy, blood pressure readings yield similar prospective utility whether measured at home, by a friend, or at the clinic. How well does personality fare in predicting health when assessed by different reporters? We don't know. The overwhelming majority of personality research examining objective health outcomes has relied solely on self-reports. In this article we use data from the Dunedin Longitudinal Study to test how well Big Five personality traits predict health when personality assessment is carried out by observers. We did this in two ways: First we asked how well do personality measures predict health when personality is assessed by observers who know Study Members well? To test this question we used informant ratings of Study Members' personalities collected from their friends, family, and peers. Next we asked how well do personality measures predict health when assessed by observers who *do not* know Study Members well? To test this question we used Study Member personality assessments completed by Dunedin Study staff members. Personality assessments by the Study Nurse and Receptionist were completed after brief encounters with Study Members in the clinical data-collection setting. These brief encounters and resulting judgments at zero acquaintance (by which we mean: "meeting for the first time") (Hirschmüller, Egloff, Nestler, & Back, 2013) are analogous to the type of interactions patients have with clinical and administrative staff in primary-care settings.

The Present Study

We tested the hypothesis that observer reports of Big Five personality traits predicted health using a prospective-longitudinal design in a population-representative cohort. We examined whether personality ratings ascertained when Study Members were young adults would predict their health at age 38, as they entered midlife. Research focusing on the capacity of personality to predict objective measures such as disease and mortality has primarily focused on the second half of the life course. This leaves a gap in our understanding of whether personality predicts health in the first half of the life course, before the typical emergence of clinical problems. To capture the integrity of physical health across multiple systems, we constructed a composite index of poor physical health using clinical indicators across multiple domains including metabolic abnormalities, cardiorespiratory fitness, pulmonary function, periodontal disease, and systemic inflammation. We evaluated the predictive utility of personality traits over and above other risk factors commonly assessed by doctors in primary care. These include factors such as Study Members' socioeconomic status, current health risks (smoking, obesity, medical conditions), self-reported health, and family history of disease. We also tested whether personality could predict whose health would deteriorate over time. The most powerful test in an observational study is whether prospectively measured personality can account for variation in subsequent within-individual health change. Accordingly, we tracked change in health using repeated measures of our index of physical health at age 26 and again at age 38.

Methods

Sample

Participants are members of the Dunedin Multidisciplinary Health and Development Study, a longitudinal investigation of health and behavior in a complete birth cohort. Study Members (N=1,037; 91% of eligible births; 52% male) were all individuals born between April 1972 and March 1973 in Dunedin, New Zealand, who were eligible for the longitudinal study based on residence in the province at age 3 and who participated in the first follow-up assessment at age 3 (Moffitt, Caspi, Rutter, & Silva, 2001). The cohort represents the full range of socioeconomic status in the general population of New Zealand's South Island and is primarily white. Assessments were carried out at birth and at ages 3, 5, 7, 9, 11, 13, 15, 18, 21, 26, 32, and, most recently, 38 years, when 95% of the 1,007 Study Members still alive took part. At each assessment wave, each Study Member is brought to the Dunedin research unit for a full day of interviews and examinations. The Otago Ethics Committee approved each phase of the study and informed consent was obtained from all Study Members.

Age 26 personality trait assessment – 25-item Informant Reports

At age 26, we asked Study Members to nominate someone who knew them well. Most informants were best friends, partners, or other family members. These 'informants' were mailed questionnaires asking them to describe the Study Member using a brief version of the Big Five Inventory (Benet-Martínez & John, 1998) which assesses individual differences on the five-factor model of personality: Extraversion (alpha= 0.79), Agreeableness (alpha = 0.75), Neuroticism (alpha = 0.83), Conscientiousness (alpha = 0.81), and Openness-to-Experience (alpha = 0.85). Each scale was measured using five items. Informant data were obtained for 946 (96%) of the 980 study members who participated in the age-26 assessment. Personality variables were standardized to the same scale using a z-score transformation. Each personality factor thus has a mean of 0 and a standard deviation of 1.

Age 32 personality trait assessment – 20-item Staff Ratings

At age 32, personality assessments were conducted by Dunedin Study Staff after brief encounters with Study Members in the clinical data-collection setting. Staff ratings were made by the Study Receptionist, who greeted each Study Member and shepherded them through the assessment day, and by the Study Nurse, who read each Study Member's blood pressure, recorded their medical history, and monitored their cardiorespiratory fitness during bicycle ergometry. Ratings were made based on a 20-item Big Five inventory (Norman, 1963). Nurse and Receptionist Ratings were collected for the first time at age 32. Each item consisted of a 7-point scale assessing a Big Five dimension: Extraversion (e.g. "talkative… silent") (alpha=0.86), Agreeableness (e.g. "friendly…suspicious, hostile") (alpha= 0.81), Neuroticism (e.g. "calm… anxious") (alpha =0.74), Conscientiousness (e.g. "responsible… undependable") (alpha=0.82), and Openness-to-Experience (e.g. "open-minded…narrow") (alpha=0.83). Staff impression ratings of Study Members' personalities were made for 935 (97%) of the 960 Study Members who participated in the age-32 assessment. Personality variables were standardized to the same scale using a z-score transformation. Each personality factor thus has a mean of 0 and a standard deviation of 1. Staff were blind to the hypothesis that personality ratings could predict health. Correlations between age-32 Nurse and Receptionist ratings of personality and between age-26 informant ratings of personality and age-32 Nurse and Receptionist ratings are shown in Table 2.

Physical health outcome at age 38

Physical examinations were conducted during the age-38 assessment day at our research Unit, with blood draws between 4:15-4:45 pm. Physical health was measured by nine clinical indicators of poor adult health, including metabolic abnormalities (waist circumference, high-density lipoprotein level, triglyceride level, blood pressure, and glycated hemoglobin), cardiorespiratory fitness, pulmonary function, periodontal disease, and systemic inflammation. Descriptions for each clinical indicator and clinical cutoffs are provided in Table 3. Pregnant women (n=9) were excluded from the reported analyses.

We created a composite index of poor physical health at age 38 by summing the number of clinical indicators on which Study members exceeded clinical cutoffs. This count of clinical indicators ranged from 0 to 9, with a positively skewed distribution (skewness= 0.91, $p<0.001$). Data were therefore categorized into five groups: 0 clinical indicators- 24.7% of Study members; 1 clinical indicator - 23.5%; 2 clinical indicators - 20.6%; 3 clinical indicators - 14.0%; 4 clinical indicators or more - 17.2 %. Table 4 shows mean values for each clinical indicator as the total count index rises. As the Table makes clear, our composite index of poor physical health represented each clinical indicator well; a higher total count of clinical indicators was significantly associated, in a dose-response manner, with higher mean values for each constituent clinical indicator (all p-values < 0.001). This composite index of poor physical health was used as the main outcome measure in data analyses.

Baseline age-26 risk factors commonly ascertained in primary-care settings

At age 26, we gathered the following information to mimic what is typically gathered in primary-care settings to guide disease prevention. 1) We assessed social disparities with information about Study members' socioeconomic origins and educational attainment; 2) health-risk factors were assessed with information about smoking and obesity – two of the top health-risks most likely to signal future disease (Lim et al., 2013; Mokdad, Marks, Stroup, & Gerberding, 2004); 3) self-reported health was assessed using questionnaires commonly used in primary care, including a) global self-reported health, b) a report of physical functioning, and c) a checklist of current or past medical conditions; 4) family medical histories were gathered as part of the Dunedin Family Health History Study (Milne et al., 2008). Descriptions for each age-26 risk factor are provided in Table 5. As expected, all these risk factors predicted poorer physical health at age 38 (Table 5, all p-values < 0.05). Risk factors were used as covariates in our longitudinal analyses and also served the secondary function of providing effect-size references against which to compare personality effects. Correlations between health-risk factors and age-26 informant ratings of personality are shown in Table 6.

Baseline physical health at age 26

A baseline-physical-health index at age 26 was constructed using the same procedures described above for age 38, with two exceptions. 1) Serum Creactive protein (CRP) was assayed in a Hitachi analyzer using an immunoturbidimetric assay (Boehringer Mannheim, Mannheim, Germany) with a sensitivity level of 1 mg/l (Hancox et al., 2007). Due to this lower sensitivity, Study members were designated as having elevated CRP if their scores were in the top quintile of the distribution. 2) Periodontal measurements were made using a half-mouth design (Thomson, Broadbent, Poulton, & Beck, 2006). Combined attachment loss for each site was assessed in a similar manner as at age 38. At age 26, Study Members had the following number of clinical indicators: 0 clinical indicators - 36.6% of Study members; 1 clinical indicator - 31.5%, 2 clinical indicators - 17.5%, 3 clinical indicators - 10.2%, 4 clinical indicators or more - 4.2 %. As expected, this baseline physical health index at 26 significantly predicted the poor physical health index at age 38 (IRR 1.36; CI [1.31-1.42] ; p<0.001).

Statistical analyses

To test which personality traits predict midlife health, we evaluated the association between informant reports of Big Five personality traits measured at baseline and physical health measured at age 38 (Model 1). All analyses controlled for sex. Poisson regressions with robust standard errors were used to calculate incident rate ratios (IRRs) for count outcomes (number of clinical health markers). To ensure the robustness of our findings we repeated our analyses using multiple estimation procedures including OLS linear regressions and ordered-logistic regressions. Results were robust to all three estimation procedures.

To test the hypothesis that personality traits predict health over and above other risk factors commonly assessed in primary care, we expanded the regression models to include age-26 baseline differences among Study members in their family socioeconomic status (Model 2), education (Model 3), health-risk factors (smoking , Model 4; obesity, Model 5), and self-reports of health and medical history (Models 6-9). We also present the results of a multivariate model (Model 10), which includes all of the above covariates simultaneously.

We tested whether personality predicts change in health from age 26 to age 38 by regressing age-38 physical health on baseline personality while controlling for baseline physical health at age 26. Since this test of intraindividual change is the most powerful test of personality effects on health in an observational study, we repeated these analyses using Staff Ratings from the age-32 assessment to test whether personality differences at zero acquaintance could predict health decline.

Results

Do Informant Reports of Personality Predict Health?

Of the Big Five personality traits measured at age 26 using informant reports, two traits – Conscientiousness and Openness-to-Experience – robustly predicted physical health at age 38 as measured by the composite index of physical health and as measured by many of its constituent indicators. Study Members who scored low on Conscientiousness and low on

Openness-to-Experience were in poorer physical health at age 38 years (Table 7 Model 1 and Table S1 Supplementary Materials).

Low Conscientiousness and low Openness-to-Experience remained significant predictors of poor physical health at age 38 even after accounting for risk factors commonly ascertained in primary-care settings, including information about social disparities (Table 7 Models 2-3), smoking (Model 4), obesity (Model 5), global self-reported health (Model 6), self-reported physical functioning (Model 7), current or past medical conditions (Model 8), and family medical history (Model 9). Furthermore, Conscientiousness and Openness-to-Experience remained significant predictors of poor health after controlling for all covariates simultaneously (Model 10).

Personality traits also helped to forecast whose health would decline the most from age 26 to age 38. On average, the entire cohort's health declined from age 26 to age 38 (t(854)=-13.54, p<0.001). However, health decline was more pronounced for individuals low in Conscientiousness (IRR 0.94 ; CI [0.90-0.99] ; p=0.017) and low in Openness-to-Experience (IRR 0.95 ; CI [0.90-0.99] ; p=0.022).

Taken collectively, these results confirm the importance of Conscientiousness in predicting physical health. These results also highlight two findings that were less expected. First, individual differences in Openness-to-Experience consistently predicted physical health. Second, individual differences in Neuroticism consistently did not predict physical health. Here, we address factors that may have contributed to these results.

Openness-to-Experience and IQ

Openness-to-Experience, alternatively termed 'Intellect' (Digman, 1997), is known to correlate positively with tested intelligence (Ackerman & Heggestad, 1997). Accumulating evidence linking intelligence to health and longevity (Deary, et al., 2011; Gottfredson & Deary, 2004) suggests that one way in which Openness-to-Experience may contribute to health is via its overlap with intelligence. We tested this hypothesis by adding information about IQ scores to our analysis. Study members with lower IQ scores were less open-to-experience (Pearson's r=0.41 ; p<0.001) and more likely to grow up to be in poor physical health (Higher IQ predicting poor Health IRR 0.86 ; CI [0.82-0.91] ; p<0.001). After controlling for IQ, Openness-to-Experience no longer predicted physical health (Table 8). In contrast, the association between Conscientiousness and poor physical health remained significant even after controlling for IQ (Table 8).

Neuroticism and subjective health assessment

Neuroticism in young adulthood did not predict objective measures of poor physical health at midlife (Table 7, Models 1-10), a finding that appears to counter psychosomatic theories suggesting aspects of neuroticism such as stress reactivity and anxiety may translate to increased susceptibility to ill-health (H. S. Friedman & Booth-Kewley, 1987; Lahey, 2009). One hypothesis is that Neuroticism is related to subjective health, but less strongly related to objective health (Costa & McCrae, 1987; Watson & Pennebaker, 1989). We tested this by substituting the age-38 measure of clinically-measured health with Study Members' global appraisals of their health at age 38 (Ware & Sherbourne, 1992). In contrast to the non-significant associations between Neuroticism and objective health, higher Neuroticism was a significant predictor of poorer self-reported subjective health at age 38 (Table 8).

Do Staff Ratings of Personality Predict Health?

Above we showed that personality ratings collected from informants who knew Study Members well could forecast which individuals would develop poor health in the ensuing 12 years. We recognize that acquiring informant reports from peers and family members who know an individual well may pose some practical challenges in primary-care settings. To address this issue we examined if personality ratings made by the Study Nurse and Receptionist – who had no prior acquaintance with Study Members and only interacted with them during clinical-data-collection– yielded a similar pattern of results. Results from these secondary analyses provide an additional robustness test of health prediction from informant-based personality ratings. Since personality ratings were performed by a nurse and receptionist, these analyses also serve to illustrate the potential utility of brief personality assessment by 3rd party observers in a setting more analogous to primary-care practice.

As perceived by Staff at zero acquaintance, Conscientiousness and Openness-to-Experience again robustly predicted physical health at age 38. Individuals low in Conscientiousness and low in Openness-to-Experience were in poorer physical health at age 38 years (Table 9, Model 1). Staff impressions of Study Members' Conscientiousness and Openness-to-Experience remained significant predictors of health decline after controlling for Study Members' baseline health at age-26 (Table 9, Model 2). Moreover, the effects of Conscientiousness and Openness-to-Experience on poor health were consistent across measurement source: Receptionist ratings and Nurse ratings of Conscientiousness and Openness-to-Experience each predicted poor health at 38, and decline in health from 26 to 38 (Table 9).

In contrast to the consistent predictions for Conscientiousness and Openness-to-Experience, staff ratings of Extraversion, Agreeableness, and Neuroticism were inconsistent in their capacity to predict health (Table 9).[1]

Discussion

This paper suggests that we need to broaden the definition of personalized medicine to include "personality." To date, personalized medicine has focused on biomarker discovery, in part to generate opportunities for prevention prior to disease onset. This has fostered expectations that personalized health planning, informed by a patient's "molecular" risk for disease and response to treatment, will soon be widely available (Evans, Meslin, Marteau, & Caulfield, 2011). Realistically, the complexities of translating molecular targets into actionable medical guidelines mean that this goal is more distant than previously anticipated (Ioannidis, 2009). Here, we show that variation observed in young adults' personality (i.e. their personality phenome) predicts health trajectories as they enter midlife. Five-item informant ratings of an individual's Conscientiousness and Openness-to-Experience when Study Members were young adults could foretell their physical health at age 38, adding incremental prognostic information even after accounting for measures routinely ascertained in primary-care settings. Even more powerfully, informant ratings of Conscientiousness and Openness-to-Experience predicted decline in physical health over a 12-year period. Moreover, fleeting encounters with Study Members provided enough of an impression for the Study Nurse and Receptionist to make personality assessments that provide prognostic value in predicting Study Members' health. These Staff impressions of Conscientiousness and Openness-to-Experience at zero acquaintance yielded similar predictive utility as informant reports despite differences in Study Member age at personality assessment and differences in the instrument used to measure the Big Five personality traits. Our findings

[1]Both Receptionist and Nurse ratings showed that Extraversion was associated with health, but these associations were no longer significant after controlling for baseline health. Neuroticism assessed by Nurse ratings was not associated with poor health in the bivariate model, but was associated with poor health when controlling for baseline health. In contrast, Neuroticism as assessed by Receptionist ratings was not associated with health in either the bivariate model or after controlling for baseline health.

suggest that integrating personality measurement into primary care may be an inexpensive and accessible way to identify which young adults are in need of their doctors' attention to promote a healthy lifestyle while they are yet young, in time to prevent disease onset.

Why do Conscientiousness and Openness-to-Experience predict health?

Several explanations may account for the association between Conscientiousness and health. Individuals high in Conscientiousness are more likely to engage in active lifestyles and maintain healthy diets (Bogg & Roberts, 2004). They tend to be more future-oriented in their thinking, so are more likely to weigh the consequences of their actions for future health (Strathman, Gleicher, Boninger, & Edwards, 1994). They also tend to exert higher levels of self-control, and so are less likely to smoke, abuse drugs or alcohol, or engage in health-risk behaviors (Bogg & Roberts, 2004), and are more likely to have successful careers and stable marriages, which are associated with positive health (Bogg & Roberts, 2013). The processes through which Conscientiousness contributes to health take shape across the life course and are intertwined with individuals' daily decisions to engage in activities that promote good health and mitigate health risks (Hampson, Andrews, Barckley, Lichtenstein, & Lee, 2000; Shanahan, Hill, Roberts, Eccles, & Friedman, 2012).

Previous studies have convincingly shown that self-reports of Conscientiousness predict health outcomes. Our analysis demonstrates that these associations are not dependent on the source of personality measurement. Third-party observers, both those who knew Study Members well and those who did not, were able to rely solely on externally expressed cues to identify the characteristic features of an individual's Conscientiousness in a manner that is predictive of health decline. In addition to bolstering the evidence base that individual differences in Conscientiousness are likely the most salient of the Big Five personality dimensions to contribute to overall health, our research also demonstrates that (at least in regards to predicting health) accurate measurement of Conscientiousness does not require privileged access to the self.

Openness-to-Experience, via its shared association with IQ, likely impacts health processes in a manner similar to intelligence (Gregory, Nettelbeck, & Wilson, 2010). Our analysis suggests that assessing Openness-to-Experience may be a simple and accessible window onto attributes of intelligence associated with future health risks. Accumulating research shows that low intelligence is linked to a broad array of health outcomes such as cancer, cardiovascular disease, and all-cause mortality (Batty & Deary, 2004; Batty, Deary, & Gottfredson, 2007; Deary, et al., 2011), associations which remain after accounting for differences in socioeconomic status (Gottfredson & Deary, 2004). People higher in intelligence are likely to have knowledge conducive to preventing age-related diseases, to seek medical attention once symptoms present, and to understand and adhere to complex regimens for management, control, and recovery after treatment begins (Batty & Deary, 2004; Beier & Ackerman, 2003; Gottfredson & Deary, 2004).

Importantly, Openness/Intellect ranks high in its degree of evaluativeness (John & Robins, 1993); people typically do not like to consider themselves as narrow, crude, or unimaginative. Self-judgments of Openness/Intellect are therefore particularly susceptible to distortion from presentation biases. This may explain the mixed findings for Openness-to-Experience in predicting health outcomes when measured using self-reports. Previous research has suggested that observer reports may result in more accurate prediction of Openness-to-Experience/Intellect and result in more unique predictive validity (Vazire, 2010). Our analysis supports this assertion. In regards to health prediction, observer ratings of low Openness-to-Experience were consistently predictive of poorer physical health.

What about Neuroticism?

The prospective utility of Neuroticism for predicting health outcomes is a matter of ongoing debate. There is broad consensus that Neuroticism predicts health complaints and health service use (B. Friedman, Veazie, Chapman, Manning, & Duberstein, 2013; Lahey, 2009). Our study confirms this finding using observer reports of Neuroticism. There is less consensus about whether Neuroticism predicts objectively measured health (Costa & McCrae, 1987; Watson & Pennebaker, 1989). While some studies have found an association between higher Neuroticism and increased morbidity and mortality (Shipley, Weiss, Der, Taylor, & Deary, 2007; Terracciano, Löckenhoff, Zonderman, Ferrucci, & Costa, 2008; Wilson et al., 2005), other studies have not (Jokela, et al., 2013). In the current study, neither informant nor Staff ratings consistently predicted objective poor health. These results should be interpreted in reference to research about what type of personality information is captured in observer ratings vs. self-reports. While observer reports rely on externally expressed cues, self-reports have privileged access to an individual's thoughts and feelings. It has been argued that this distinction may result in asymmetry between self- and observer-reports for traits such as Neuroticism (Vazire, 2010). We did not collect self-reports of Big Five personality traits and so we could not compare health prediction between observer- and self-reports of personality directly. Although we demonstrate that observer ratings of personality predict future health, we do not rule out the potential of self-report measures to provide equally valuable inferences. Thus, while the association between Neuroticism and health appears less robust than Conscientiousness, the extent to which self-reports of Neuroticism predict objective health remains an open question.

Limitations

This study has several limitations. First we did not collect self-reports of Big Five personality and thus could not directly compare the predictive utility of observer ratings to self-report ratings. Rather, we relied on a substantial literature demonstrating links between self-reported personality and health to serve as the reference point for our examination of observer-reported personality and health.

Second, the personality effects we report are small, but these should be evaluated relative to other well-established risk factors for poor health. Notably, the contributions of Conscientiousness (IRR 0.91) and Openness-to-Experience (IRR 0.91) to future health are on par with the contributions of socioeconomic status, education, self-reported health, smoking, and family medical history (presented in Table 5, right column).

Third, the health outcomes we examined were right-censored at 38 years, our most recent assessment. Accordingly, we examined clinical indicators rather than endpoints such as cardiovascular disease, chronic obstructive pulmonary disease, and mortality. However, all of the clinical indicators reported here are well-characterized, and have prognostic utility as early warning measures for morbidity and mortality (Blair et al., 1996; Danesh et al., 2000; Eckel, Alberti, Grundy, & Zimmet, 2010; Rasmussen et al., 2002). Future analysis of the Dunedin cohort will also allow us to examine which personality traits are important for healthy aging later in life; for example, Extraversion and Agreeableness, linked to the development and maintenance of social support (Cohen, 2004; Uchino, 2009), may promote health in later ages (Rosengren, Orth-Gomér, Wedel, & Wilhelmsen, 1993; Rozanski, Blumenthal, & Kaplan, 1999). Neuroticism, linked to poorer subjective health, is a predictor of mortality in older ages even after accounting for objective health risks (Idler & Benyamini, 1997; Wilson, de Leon, Bienias, Evans, & Bennett, 2004).

Fourth, our study is limited to a cohort of individuals who were born in New Zealand in the 1970s, and who have access to socialized healthcare. The universality of the Big Five personality dimensions (Benet-Martínez & John, 1998; McCrae & Terracciano, 2005) suggests that findings from New Zealand should apply to other countries and cultures. Further, it is possible that the associations we report here may be even more pronounced in countries where healthcare is less accessible and accessing it requires greater conscientious effort.

Next Steps

Healthcare reform in the US is leading to a substantial increase in newly-insured young adults (Sommers & Kronick, 2012). This rapid increase presents a timely opportunity for healthcare professionals to encourage young adults to supplant the health-risk behaviors of youth with health-promoting habits for midlife. However, clinical guidelines for preventive health in young adults are sparse, disorganized, and "can't be found" (Ozer, Urquhart, Brindis, Park, & Irwin, 2012). Our findings suggest that integrating personality measurement may help physicians and nurses anticipate which young adults will be at greater risk for developing poor health, in some cases before the presence of elevated clinical indicators. To address this goal, implementation research is needed to establish the cost, feasibility, and utility of integrating personality measurement into clinical practice (Ioannidis, 2009).

We foresee three important areas of inquiry: First, research should examine whether self-reports or observer reports of personality are more appropriate in clinical settings. Self-reports have known social desirability biases, and such effects may be compounded if patients were to complete personality questionnaires knowing that the outcome could affect the type of medical treatment they would receive. Further, if confidentiality of personality ratings were not guaranteed would reporters – self or other – be willing to be frank? We need research on acceptability to understand people's willingness to provide personality data in real-world settings.

Second, implementation research also has the potential to advance personality theory. Research psychologists tend to think that theory guides implementation, but it is also the case that implementation can improve theory testing. Hospitals and care providers are beginning to link comprehensive records of health service use, lab tests, diagnoses and drug prescriptions into centralized electronic systems that will capture the complexity of interaction with the health-care system for enormous numbers of individuals. Adding personality measures to electronic infrastructures of health records could provide an invaluable data resource for researchers to examine how personality and health interact over time, in the real world. One such system, the NIH-funded Patient Reported Outcomes Measurement Information System (PROMIS), makes use of brief self-report metrics to help clinicians and researchers design treatment plans and improve communication (Cella et al., 2010). Personality measures are not currently in the PROMIS questionnaire bank; the present findings provide impetus for testing these measures' translational potential.

Third, personality measurement may improve communication and collaboration between patients and healthcare professionals, by making professionals more aware of each patient's personal lifestyle preferences. Research shows that such patient-centered approaches improve delivery of preventive services and the management of chronic conditions (Starfield & Shi, 2004; Starfield, Shi, & Macinko, 2005). Randomized controlled trials should be conducted in which health-care providers either have access to personality information or not. Does personality information produce improved patient outcomes?

Our research also has implications for public health. There is ongoing debate about how to address behavioral risk factors for chronic disease, such as sedentary lifestyle, smoking, and poor diet. Our findings suggest that interventions requiring effortful planning, self-control,

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and strict adherence are less likely to be effective for segments of the population in which these psychological resources are in shortest supply (i.e. individuals low in Conscientiousness). In contrast, strategically tailoring messages to individuals low in Conscientiousness may increase the appeal of health-promotion communication, and the effectiveness of health-promotion interventions (Conrod et al., 2013; Hirsh, Kang, & Bodenhausen, 2012). In addition, programs that manipulate choice architecture to increase the likelihood of healthy decision-making may produce particular benefits for those individuals whose lack of Conscientiousness otherwise works against their health (Downs, Loewenstein, & Wisdom, 2009; Marteau, Ogilvie, Roland, Suhrcke, & Kelly, 2011; Thaler & Sunstein, 2008). More broadly, our findings suggest that in addition to the "what" of chronic age-related diseases – the specific behaviors and pathophysiology that cause illness – preventive medicine may also benefit from attending to the "who" – characteristic differences in personality – in order to design effective interventions.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

Ackerman PL, Heggestad ED. Intelligence, personality, and interests: evidence for overlapping traits. Psychological Bulletin. 1997; 121(2):219–245. [PubMed: 9100487]

Batty GD, Deary IJ. Early life intelligence and adult health. BMJ: British Medical Journal. 2004; 329(7466):585–586.

Batty GD, Deary IJ, Gottfredson LS. Premorbid (early life) IQ and later mortality risk: systematic review. Annals of Epidemiology. 2007; 17(4):278–288. [PubMed: 17174570]

Beier ME, Ackerman PL. Determinants of health knowledge: an investigation of age, gender, abilities, personality, and interests. Journal of Personality and Social Psychology. 2003; 84(2):439–447. [PubMed: 12585815]

Benet-Martínez V, John OP. Los Cinco Grandes across cultures and ethnic groups: Multitrait-multimethod analyses of the Big Five in Spanish and English. Journal of Personality and Social Psychology. 1998; 75(3):729–750. [PubMed: 9781409]

Berger JS, Jordan CO, Lloyd-Jones D, Blumenthal RS. Screening for cardiovascular risk in asymptomatic patients. Journal of the American College of Cardiology. 2010; 55(12):1169–1177. [PubMed: 20298922]

Berry JD, Lloyd-Jones DM, Garside DB, Greenland P. Framingham risk score and prediction of coronary heart disease death in young men. American Heart Journal. 2007; 154(1):80–86. [PubMed: 17584558]

Blair SN, Kampert JB, Kohl HW III, Barlow CE, Macera CA, Paffenbarger RS Jr, Gibbons LW. Influences of cardiorespiratory fitness and other precursors on cardiovascular disease and all-cause mortality in men and women. JAMA. 1996; 276(3):205–210. [PubMed: 8667564]

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]

Bogg T, Roberts BW. The case for conscientiousness: Evidence and implications for a personality trait marker of health and longevity. Annals of Behavioral Medicine. 2013; 45:278–288. [PubMed: 23225322]

Booth-Kewley S, Friedman HS. Psychological predictors of heart disease: a quantitative review. Psychological Bulletin. 1987; 101(3):343–362. [PubMed: 3602244]

Carver CS, Connor-Smith J. Personality and coping. Annual Review of Psychology. 2010; 61:679–704.

Cella D, Riley W, Stone A, Rothrock N, Reeve B, Yount S, Choi S. Initial Adult Health Item Banks and First Wave Testing of the Patient-Reported Outcomes Measurement Information System (PROMIS™) Network: 2005–2008. Journal of Clinical Epidemiology. 2010; 63(11):1179–1194. [PubMed: 20685078]

Chapman BP, Hampson S, Clarkin J. Personality-Informed Prevention and Intervention for Healthy Aging. Developmental Psychology. in press.

Chapman BP, Roberts B, Duberstein P. Personality and longevity: knowns, unknowns, and implications for public health and personalized medicine. Journal of Aging Research. 20112011

Cohen S. Social relationships and health. American Psychologist. 2004; 59(8):676–684. [PubMed: 15554821]

Conrod PJ, O'Leary-Barrett M, Newton N, Topper L, Castellanos-Ryan N, Mackie C, Girard A. Effectiveness of a Selective, Personality-Targeted Prevention Program for Adolescent Alcohol Use and Misuse: A Cluster Randomized Controlled Trial. JAMA Psychiatry. 2013; 70(3):334–342. [PubMed: 23344135]

Costa PT, McCrae RR. Neuroticism, somatic complaints, and disease: Is the bark worse than the bite? Journal of Personality. 1987; 55(2):299–316. [PubMed: 3612472]

Cuzick J. A wilcoxon-type test for trend. Statistics in Medicine. 1985; 4(4):543–547. [PubMed: 4089356]

Danesh J, Whincup P, Walker M, Lennon L, Thomson A, Appleby P, Pepys MB. Low grade inflammation and coronary heart disease: prospective study and updated meta-analyses. BMJ: British Medical Journal. 2000; 321(7255):199–204.

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. 2011; 11(2):53–79. doi: 10.1177/1529100610387081.

Digman JM. Personality structure: Emergence of the five-factor model. Annual Review of Psychology. 1990; 41(1):417–440.

Digman JM. Higher-order factors of the Big Five. Journal of Personality and Social Psychology. 1997; 73(6):1246–1256. [PubMed: 9418278]

Downs JS, Loewenstein G, Wisdom J. Strategies for promoting healthier food choices. The American Economic Review. 2009:159–164.

Eckel RH, Alberti K, Grundy SM, Zimmet PZ. The metabolic syndrome. The Lancet. 2010; 375(9710):181–183.

Evans JP, Meslin EM, Marteau TM, Caulfield T. Deflating the genomic bubble. Science. 2011; 331(6019):861–862. [PubMed: 21330519]

Ferguson E, Bibby PA. Openness to experience and all-cause mortality: A meta-analysis and requivalent from risk ratios and odds ratios. British Journal of Health Psychology. 2012; 17(1):85–102. [PubMed: 22107453]

Friedman B, Veazie PJ, Chapman BP, Manning WG, Duberstein PR. Is Personality Associated with Health Care Use by Older Adults? Milbank Quarterly. 2013; 91(3):491–527. doi: 10.1111/1468-0009.12024. [PubMed: 24028697]

Friedman HS, Booth-Kewley S. The "disease-prone personality": A meta-analytic view of the construct. American Psychologist. 1987; 42(6):539–555. [PubMed: 3619180]

Funder, DC. The personality puzzle. WW Norton & Co.; New York: 1997.

Gottfredson LS, Deary IJ. Intelligence predicts health and longevity, but why? Current Directions in Psychological Science. 2004; 13(1):1–4.

Gregory T, Nettelbeck T, Wilson C. Openness to experience, intelligence, and successful ageing. Personality and Individual Differences. 2010; 48(8):895–899.

Hampson SE. Personality processes: mechanisms by which personality traits “get outside the skin”. Annual Review of Psychology. 2012; 63:315–339. doi: 10.1146/annurev-psych-120710-100419.

Hampson SE, Andrews JA, Barckley M, Lichtenstein E, Lee ME. Conscientiousness, perceived risk, and risk-reduction behaviors: A preliminary study. Health Psychology. 2000; 19(5):496–500. [PubMed: 11007158]

Hancox RJ, Poulton R, Greene JM, Filsell S, McLachlan CR, Rasmussen F, Sears MR. Systemic inflammation and lung function in young adults. Thorax. 2007; 62(12):1064–1068. [PubMed: 17604302]

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]

Hirschmüller S, Egloff B, Nestler S, Back MD. The dual lens model: A comprehensive framework for understanding self–other agreement of personality judgments at zero acquaintance. Journal of Personality and Social Psychology. 2013; 104(2):335–353. [PubMed: 23046068]

Hirsh JB, Kang SK, Bodenhausen GV. Personalized Persuasion Tailoring Persuasive Appeals to Recipients’ Personality Traits. Psychological Science. 2012; 23(6):578–581. [PubMed: 22547658]

Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. Journal of Health and Social Behavior. 1997:21–37. [PubMed: 9097506]

Ioannidis JP. Personalized genetic prediction: too limited, too expensive, or too soon? Annals of Internal Medicine. 2009; 150(2):139–141. [PubMed: 19153414]

Israel S, Moffitt TE. Conscientiousness in primary care: An opportunity for prevention and health promotion. Developmental Psychology. in press.

John OP, Robins RW. Determinants of interjudge agreement on personality traits: The Big Five domains, observability, evaluativeness, and the unique perspective of the self. Journal of Personality. 1993; 61(4):521–551. [PubMed: 8151500]

John, OP.; Robins, RW.; Pervin, LA. Handbook of personality: Theory and research. The Guilford Press; New York: 2010.

John, OP.; Srivastava, S. The Big Five trait taxonomy: History, measurement, and theoretical perspectives. In: John, OP.; Pervin, LA., editors. Handbook of personality: Theory and research. Vol. 2. The Guilford Press; New York: 1999. p. 102-138.

Jokela M, Batty GD, Nyberg ST, Virtanen M, Nabi H, Singh-Manoux A, Kivimäki M. Personality and all-cause mortality: individual-participant meta-analysis of 3,947 deaths in 76,150 adults. American Journal of Epidemiology. 2013; 178(5):667–675. [PubMed: 23911610]

Kavey R, Simons-Morton D, de Jesus J. Expert panel on integrated guidelines for cardiovascular health and risk reduction in children and adolescents: summary report. Pediatrics. 2011; 128(suppl 5):S213–S256. [PubMed: 22084329]

Kern ML, Friedman HS. Do conscientious individuals live longer? A quantitative review. Health Psychology. 2008; 27(5):505–512. [PubMed: 18823176]

Lahey BB. Public health significance of neuroticism. American Psychologist. 2009; 64(4):241–256. [PubMed: 19449983]

Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H, Aryee M. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. The Lancet. 2013; 380(9859):2224–2260.

Marshall GN, Wortman CB, Vickers RR, Kusulas JW, Hervig LK. The five-factor model of personality as a framework for personality health research. Journal of Personality and Social Psychology. 1994; 67(2):278–286. [PubMed: 7932063]

Marteau TM, Ogilvie D, Roland M, Suhrcke M, Kelly MP. Judging nudging: can nudging improve population health? BMJ: British Medical Journal. 2011; 342:d228.

McCrae RR, John OP. An introduction to the five-factor model and its applications. Journal of Personality. 1992; 60(2):175–215. [PubMed: 1635039]

McCrae RR, Terracciano A. Universal features of personality traits from the observer's perspective: data from 50 cultures. Journal of Personality and Social Psychology. 2005; 88(3):547–561. [PubMed: 15740445]

McGill HC Jr, McMahan CA. Starting earlier to prevent heart disease. JAMA. 2003; 290(17):2320–2322. [PubMed: 14600192]

McHorney CA, War JE Jr, Lu JR, Sherbourne CD. The MOS 36-item Short-Form Health Survey (SF-36): III. Tests of data quality, scaling assumptions, and reliability across diverse patient groups. Medical Care. 1994:40–66. [PubMed: 8277801]

Milne B, Moffitt TE, Crump R, Poulton R, Rutter M, Sears M, Caspi A. How should we construct psychiatric family history scores? A comparison of alternative approaches from the Dunedin Family Health History Study. Psychological Medicine. 2008; 38(12):1793–1802. [PubMed: 18366822]

Moffitt TE, Caspi A, Harkness AR, Silva PA. The Natural History of Change to Intellectual Performance: Who Changes? How Much? Is it Meaningful? Journal of Child Psychology and Psychiatry. 1993; 34(4):455–506. [PubMed: 8509490]

Moffitt, TE.; Caspi, A.; Rutter, M.; Silva, PA. Sex differences in antisocial behaviour: Conduct disorder, delinquency, and violence in the Dunedin Longitudinal Study. Cambridge University Press; New York: 2001.

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]

Norman WT. Toward an adequate taxonomy of personality attributes: Replicated factor structure in peer nomination personality ratings. Journal of Abnormal and Social Psychology. 1963; 66(6): 574–583. [PubMed: 13938947]

Ozer EM, Urquhart JT, Brindis CD, Park MJ, Irwin CE. Young adult preventive health care guidelines: there but can't be found. Archives of Pediatrics and Adolescent Medicine. 2012; 166(3):240–247. [PubMed: 22393182]

Pearson TA, Mensah GA, Alexander RW, Anderson JL, Cannon RO III, Criqui M, Myers GL. Markers of inflammation and cardiovascular disease. Circulation. 2003; 107(3):499–511. [PubMed: 12551878]

Perloff D, Grim C, Flack J, Frohlich E, Hill M, McDonald M, Morgenstern B. Human blood pressure determination by sphygmomanometry. Circulation. 1993; 88(5):2460–2470. [PubMed: 8222141]

Rabe KF, Hurd S, Anzueto A, Barnes PJ, Buist SA, Calverley P, van Weel C. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease GOLD executive summary. American Journal of Respiratory and Critical Care Medicine. 2007; 176(6): 532–555. [PubMed: 17507545]

Rasmussen F, Taylor DR, Flannery EM, Cowan JO, Greene JM, Herbison GP, Sears MR. Risk Factors for Airway Remodeling in Asthma Manifested by a Low Postbronchodilator FEV1/Vital Capacity Ratio A Longitudinal Population Study from Childhood to Adulthood. American Journal of Respiratory and Critical Care Medicine. 2002; 165(11):1480–1488. [PubMed: 12045120]

Roberts BW. Back to the future: Personality and Assessment and personality development. Journal of Research in Personality. 2009; 43(2):137–145. [PubMed: 20161194]

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.

Rosengren A, Orth-Gomér K, Wedel H, Wilhelmsen L. Stressful life events, social support, and mortality in men born in 1933. BMJ: British Medical Journal. 1993; 307(6912):1102–1105.

Rozanski A, Blumenthal JA, Kaplan J. Impact of psychological factors on the pathogenesis of cardiovascular disease and implications for therapy. Circulation. 1999; 99(16):2192–2217. [PubMed: 10217662]

Shanahan MJ, Hill PL, Roberts BW, Eccles J, Friedman HS. Conscientiousness, Health, and Aging: The Life Course of Personality Model. Developmental Psychology. 2012

Shipley BA, Weiss A, Der G, Taylor MD, Deary IJ. Neuroticism, extraversion, and mortality in the UK Health and Lifestyle Survey: a 21-year prospective cohort study. Psychosomatic Medicine. 2007; 69(9):923–931. [PubMed: 17991814]

Smith, M.; Saunders, R.; Stuckhardt, L.; McGinnis, JM. Best Care at Lower Cost: The Path to Continuously Learning Health Care in America. National Academies Press; 2013.

Smith TW. Personality as risk and resilience in physical health. Current Directions in Psychological Science. 2006; 15(5):227–231.

Smith TW, Williams PG. Personality and Health: Advantages and Limitations of the Five-Factor Model. Journal of Personality. 1992; 60(2):395–425. [PubMed: 1635048]

Sommers BD, Kronick R. The Affordable Care Act and Insurance Coverage for Young Adults. JAMA. 2012; 307(9):913–914. [PubMed: 22396509]

Standardization of Spirometry - 1994 Update. American Journal of Respiratory and Critical Care Medicine. 1995; 152(3):1107–1136. [PubMed: 7663792]

Starfield B, Shi L. The medical home, access to care, and insurance: a review of evidence. Pediatrics. 2004; 113(Supplement 4):1493–1498. [PubMed: 15121917]

Starfield B, Shi L, Macinko J. Contribution of primary care to health systems and health. Milbank Quarterly. 2005; 83(3):457–502. [PubMed: 16202000]

Strathman A, Gleicher F, Boninger DS, Edwards CS. The consideration of future consequences: Weighing immediate and distant outcomes of behavior. Journal of Personality and Social Psychology. 1994; 66(4):742–752.

Sutin AR, Ferrucci L, Zonderman AB, Terracciano A. Personality and obesity across the adult life span. Journal of Personality and Social Psychology. 2011; 101(3):579–592. doi: 10.1037/a0024286. [PubMed: 21744974]

Sutin AR, Scuteri A, Lakatta EG, Tarasov KV, Ferrucci L, Costa PT, Terracciano A. Trait Antagonism and the Progression of Arterial Thickening Women With Antagonistic Traits Have Similar Carotid Arterial Thickness as Men. Hypertension. 2010; 56(4):617–622. [PubMed: 20713913]

Terracciano A, Löckenhoff CE, Zonderman AB, Ferrucci L, Costa PT. Personality predictors of longevity: activity, emotional stability, and conscientiousness. Psychosomatic Medicine. 2008; 70(6):621–627. [PubMed: 18596250]

Thaler, RH.; Sunstein, CR. Nudge: Improving decisions about health, wealth, and happiness. Yale University Press; 2008.

Thomson WM, Broadbent JM, Poulton R, Beck JD. Changes in periodontal disease experience from 26 to 32 years of age in a birth cohort. Journal of Periodontology. 2006; 77(6):947–954. [PubMed: 16734567]

Turiano NA, Spiro A, Mroczek DK. Openness to Experience and Mortality in Men Analysis of Trait and Facets. Journal of Aging and Health. 2012; 24(4):654–672. [PubMed: 22219209]

Uchino BN. Understanding the links between social support and physical health: A life-span perspective with emphasis on the separability of perceived and received support. Perspectives on Psychological Science. 2009; 4(3):236–255.

Vazire S. Who knows what about a person? The self–other knowledge asymmetry (SOKA) model. Journal of Personality and Social Psychology. 2010; 98(2):281–300. [PubMed: 20085401]

Ware JE, Sherbourne CD. The MOS 36-item short-form health survey (SF-36): I. Conceptual framework and item selection. Medical Care. 1992:473–483. [PubMed: 1593914]

Watson D, Pennebaker JW. Health complaints, stress, and distress: exploring the central role of negative affectivity. Psychological Review. 1989; 96(2):234–254. [PubMed: 2710874]

Weintraub WS, Daniels SR, Burke LE, Franklin BA, Goff DC Jr, Hayman LL, Schram AP. Value of primordial and primary prevention for cardiovascular disease a policy statement from the American Heart Association. Circulation. 2011; 124(8):967–990. [PubMed: 21788592]

Wilson RS, de Leon CFM, Bienias JL, Evans DA, Bennett DA. Personality and mortality in old age. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences. 2004; 59(3):P110–P116.

Wilson RS, Krueger KR, Gu L, Bienias JL, de Leon CFM, Evans DA. Neuroticism, extraversion, and mortality in a defined population of older persons. Psychosomatic Medicine. 2005; 67(6):841–84.5. [PubMed: 16314587]

Table 1

Descriptions of Typical High and Low Scorers for the Big Five Personality Traits

Personality Trait	Description of a Typical High Scorer	Description of a Typical Low Scorer
Extraversion	Outgoing, expressive, energetic, dominant	Quiet, lethargic, content to follow others' lead
Agreeableness	Cooperative, considerate, empathic, generous, polite, and kind	Aggressive, rude, spiteful, stubborn, cynical, and manipulative
Neuroticism	Anxious, vulnerable to stress, guilt-prone, lacking in confidence, moody, angry, easily frustrated, and insecure in relationships	Emotionally stable, adaptable, and sturdy
Conscientiousness	Responsible, attentive, careful, persistent, orderly, planful, and future-oriented	Irresponsible, unreliable, careless, distractible, and impulsive
Openness-to-Experience	Imaginative, creative, aesthetically sensitive, quick to learn, clever, insightful, attentive and aware of feelings	Resistant to change, conventional, prefers the plain, straightforward, and routine over the complex, subtle, and abstract

Table 2

Correlations between Age-26 Informant and Age-32 Staff Ratings of Personality

	Extraversion	Agreeableness	Neuroticism	Conscientiousness	Openness-to-Experience
Informant ratings at age 26 to Nurse ratings at age 32	0.26***	0.19***	0.09**	0.15***	0.21***
Informant ratings at age 26 to Receptionist ratings at age 32	0.29***	0.22***	0.17***	0.22***	0.23***
Nurse ratings at age 32 to Receptionist ratings at age 32	0.35***	0.28***	0.15***	0.24***	0.36***

** Indicates that correlations are significant at the level $p<0.01$

*** at $p<0.001$

Table 3

Description of Age-38 Clinical Indicators of Poor Physical Health

Clinical Indicator	*Description*	*Prevalence at Age 38*	
		Males	***Females***
Metabolic Abnormalities	We assessed metabolic abnormalities by measuring 5 clinical indicators: obesity, high density lipoprotein (HDL) cholesterol level, triglyceride level, blood pressure, and glycated hemoglobin concentration.		
Obesity[1]	To determine obesity, we measured waist circumference (in centimeters). Study members were considered obese if their waist measurement was greater than 88 cm for women or greater than 102 cm for men.	16%,	25%
High-Density Lipoprotein Level[1]	Study members were considered to have a low HDL cholesterol level if the value was 40mg/dL (1.04mmol/L) or lower for men and 50 mg/dL (1.3 mmol/L) or less for women.	26%,	25%
Triglyceride Level[1]	Study members were considered to have an elevated triglyceride level if their reading was 2.26 mmol/l or greater.	50%,	14%
Blood Pressure[1]	Blood pressure (in millimeters of mercury) was assessed according to standard protocols (Perloff et al., 1993). Study members were considered to have high blood pressure if their systolic reading was 130 mm Hg or higher or if their diastolic reading was 85 mm Hg or higher.	38%,	16%
Glycated Hemoglobin[2]	Glycated hemoglobin concentrations (expressed as a percentage of total hemoglobin) were measured by ion exchange high performance liquid chromatography (Variant II; Bio-Rad, Hercules, Calif) (coefficient of variation, 2.4%), a method certified by the US National Glycohemoglobin Standardization Program (NGSP) http://www.missouri.edu/~diabetes/ngsp.html). Study members were designated as having this health risk if their scores were greater than 5.7%, the cutoff for pre-diabetes.	23%,	14%
Cardiorespiratory Fitness	Maximum oxygen consumption adjusted for body weight (in milliliters per minute per kilogram) was assessed by measuring heart rate in response to a submaximal exercise test on a friction-braked cycle ergometer, and calculated by standard protocols. Sex-specific quintiles were formed. Following Blair et al. (Blair, et al., 1996), study members in the lowest quintile were considered to have this health risk.	20%,	20%
Pulmonary Function	Pulmonary function was assessed using a computerized spirometer and body plethysmograph ("Standardization of Spirometry - 1994 Update," 1995). Measurements of vital capacity were repeated to obtain at least three repeatable values (within 5%) followed by full-forced expiratory maneuvers to record the forced expiratory volume in 1s (FEV1): The post-bronchodilator FEV1/FVC ratio after 200 mg salbutamol is reported as the primary lung function measure because it is the most sensitive measure for assessing airway remodeling in a large cohort. Study members with an FEV1/FVC ratio below .70 were classified as having significant airflow limitation (Rabe et al., 2007).	9%,	5%
Periodontal Disease	Examinations were conducted in all 4 quadrants using calibrated dental examiners; three sites (mesiobuccal, buccal, and distolingual) per tooth were examined, and gingival recession (the distance in millimeters from the cementoenamel junction to the gingival margin) and probing depth (the distance from the probe tip to the gingival margin) were recorded using a PCP-2 probe. The combined attachment loss (CAL) for each site was computed by summing gingival recession and probing depth (third molars were not included). We report the	28%,	18%

Clinical Indicator	Description	Prevalence at Age 38	
		Males	**Females**
	presence of periodontal disease, defined as 1+ site(s) with 5 or more mm of combined attachment loss (Thomson, et al., 2006).		
Systemic Inflammation	Elevation in inflammation was assessed by assaying high-sensitivity C-Reactive Protein (hsCRP, mg/L). High-sensitivity C-reactive protein level is thought to be one of the most reliable measured indicators of vascular inflammation and has been recently endorsed as an adjunct to traditional risk factor screening for cardiovascular risk. hsCRP was measured on a Hitachi 917 analyzer (Roche Diagnostics, GmbH, D-68298, Mannheim, Germany) using a particle enhanced immunoturbidimetric assay. The CDC/AHA definition of high cardiovascular risk (hsCRP >3 mg/L) was adopted to identify our risk group (Pearson et al., 2003).	16%,	26%

[1]Based on the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) http://www.nhlbi.nih.gov/guidelines/cholesterol/index.htm

[2]Based on the NGSP clinical advisory committee 2010 recommendation http://www.ngsp.org/cac2010.asp

Table 4

Mean Values of Each Clinical Indicator at Age 38 as a Function of Total Number of Clinical Indicators

	Mean Values by Total Number of Clinical Indicators at Age 38[1]						P value for Trend[2]
	0	**1**	**2**	**3**	**4+**	**z-value**	
N	219	208	183	124	153		
Metabolic Abnormalities							
Waist (cm)	773	818	862	912	1018	19.7	<0.001
HDL (mmol/L)	1.73	1.56	1.39	1.27	1.09	−16.9	<0.001
Triglycerides (mmol/L)	1.20	1.63	2.15	2.54	3.38	16.3	<0.001
Systolic BP (mmHg)	113	118	122	123	129	12.8	<0.001
Diastolic BP (mmHg)	73	76	79	81	86	13.2	<0.001
Glycated Hemoglobin (%)	5.26	5.33	5.37	5.45	5.73	9.0	<0.001
Cardiorespiratory Fitness (VO_2 max)	30.5	31.6	30.2	29.0	23.6	−8.0	<0.001
Pulmonary Function (FEV1/FVC ratio)	81.8	80.1	79.1	79.1	78.6	−4.0	<0.001
Periodontitis (% of sites with 5+mm CAL)	0.00	1.62	3.19	4.95	4.14	9.9	<0.001
Systemic Inflammation (hsCRP mg/L)	0.86	1.54	2.27	3.81	4.89	14.9	<0.001

[1] Total count of clinical indicators based on clinical cutoff values detailed in Table 2

[2] Calculated based on Wilcoxon-type test for trend (Cuzick, 1985)

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Table 5

Description of Age-26 Risk Factors Commonly Ascertained in Primary Care

	Health-Risk Factor	*Description*	*Prediction of Age-38 Physical Health*		
			IRR[1]	**[95% CI]**	**P-value**
Social Disparities	Family Socioeconomic Status	The socioeconomic status of Study members was measured with a 6-point scale assessing parents' occupational status. The scale places each occupation into 1 of 6 categories (from 1, unskilled laborer to 6, professional) on the basis of educational levels and income associated with that occupation in data from the New Zealand census.	0.87	[0.83 - 0.91]	<0.001
	Education	Education level was measured on a 4-point scale relevant to the New Zealand educational system (0 = no school certificate, 1 = school certificate, 2 = high school graduate or equivalent, 3 = BA or higher)	0.89	[0.85 - 0.94]	<0.001
Health-Risk Factors	Smoking	At age 26 years those who reported that they had smoked those who reported that they had smoked daily for at least 1 month of the previous year were considered to have 'been a daily smoker'.	1.10	[1.05 - 1.16]	<0.001
	Obesity	Individuals' height and weight were measured at age 26. Height was measured to the nearest millimeter using a portable stadiometer (Harpenden; Holtain, Ltd). Weight was measured to the nearest 0.1 kg using calibrated scales. Individuals were weighed in light clothing. Obesity was defined as a body mass index of 30 or greater.	1.25	[1.21 - 1.29]	<0.001
Self-Reports of Health	Global Self-Reported Health	Self-reported health at age 26 years was assessed with the first item of the SF-36 general health survey "In general, would you say your health is: excellent, very good, good, fair, poor?" (Ware & Sherbourne, 1992)	0.89	[0.84 - 0.93]	<0.001
	Physical Functioning	At age 26 years, study member responses ("limited a lot," "limited a little," "not limited at all") to the 10-item SF-36 physical functioning scale (Ware & Sherbourne, 1992) assessed their degree of difficulty in completing various activities, e.g., climbing several flights of stairs, walking more than 1 km, participating in strenuous sports. Item scores were linearly transformed to create an overall index ranging from 100 (no limitations) to 0 (severe limitations) (McHorney, War Jr, Lu, & Sherbourne, 1994) .	0.91	[0.87 - 0.95]	<0.001
	Current or Past Medical Conditions	Count of self-report of the following conditions: anemia, arthritis, asthma, allergies, cancer, hepatitis, diabetes, heart trouble, kidney or bladder infection, epilepsy, acne, eczema, major surgery, serious injury, menstrual problems (women only), headaches, vision problems (other than glasses), hearing problems, blood pressure, cholesterol, disability due to injury or long-term health problem, or other medical condition that needs regular treatment (based on Study member responses to the stem "Have you ever been told/ suffered from______"	1.07	[1.01 - 1.13]	0.016
	Family Medical History	In 2003-2006, the history of physical disorders was assessed for the Study members' first- and second-degree relatives, by interviewing Study members and their biological parents (Milne, et al., 2008). The following family histories were assessed: gum disease, high blood pressure, stroke, high cholesterol, diabetes, and heart disease (defined as a history of heart attack, balloon angioplasty, coronary bypass, or angina). The Family Medical History score is the proportion of a Study member's extended family with a positive history of disorder, summed over all	1.09	[1.04 - 1.15]	<0.001

Health-Risk Factor	*Description*	*Prediction of Age-38 Physical Health*		
		IRR[1]	**[95% CI]**	**P-value**
	disorders.			

[1]To facilitate comparison across health-risk factors all variables were standardized to a mean of 0 and SD of 1. Incident rate ratios are based on Poisson regressions, controlling for sex, using the composite index of poor physical health at age 38 as the outcome measure

Table 6

Correlations between Age-26 Big Five Personality Traits, Health Risk Factors, and Age-26 Index of Poor Health

	Extraversion	Agreeableness	Neuroticism	Conscientiousness	Openness-to-Experience
Family Socioeconomic Status	0.09 **	0.10 **	−0.10 **	0.04	0.19 ***
Education	0.12 ***	0.20 ***	−0 19 ***	0.20 ***	0.27 ***
Smoking	−0.01	−0 17 ***	0.15 ***	−0.16 ***	−0.05
Obesity	0.01	0.05	0.02	−0.05	−0.04
Global Self-Reported Health	0.06	0.10 **	−0 17 ***	0.15 ***	0.05
Physical Functioning	0.01	0.04	−0.14 ***	0.12 ***	0.03
Current or Past Medical Conditions	0.10 **	−0.03	0.20 ***	−0.03	0.05
Family Medical History	−0.01	0.04	0.00	0.02	−0.02
Poor Health Index at Age 26	−0.07 *	−0.02	−0.01	−0.12 ***	−0.10 **

* Indicates that correlations are significant at the level $p<0.05$

** at $p<0.01$

*** at $p<0.001$

Table 7

Association between Personality at Age 26 and Physical Health at age 38

		Extraversion			Agreeableness			Neuroticism			Conscientiousness			Openness-to-Experience		
	Model Description	IRR	[95% CI]	pvalue	IRR	[95% CI]	pvalue	IRR	[95% CI]	pvalue	IRR	[95% CI]	pvalue	IRR	[95% CI]	pvalue
Model 1	Bivariate	0.95	[0.90 - 1.00]	0.068	0.96	[0.91 - 1.01]	0.092	1.04	[0.99 - 1.09]	0.158	0.91	[0.86 - 0.96]	0.001	0.91	[0.87 - 0.96]	0.001
	Social Disparities															
Model 2	Family Socioeconomic Status	0.97	[0.92 - 1.02]	0.206	0.97	[0.92 - 1.02]	0.217	1.03	[0.97 - 1.08]	0.319	0.91	[0.87 - 0.96]	0.001	0.93	[0.89 - 0.98]	0.010
Model 3	Education	0.96	[0.92 - 1.02]	0.170	0.98	[0.93 - 1.03]	0.387	1.02	[0.96 - 1.07]	0.572	0.93	[0.88 - 0.98]	0.004	0.94	[0.89 - 0.99]	0.017
	Health Risk Factors at Age 26															
Model 4	Smoking	0.96	[0.91 - 1.01]	0.118	0.97	[0.93 - 1.02]	0.315	1.02	[0.97 - 1.08]	0.375	0.92	[0.87 - 0.97]	0.004	0.92	[0.87 - 0.97]	0.002
Model 5	Obesity	0.95	[0.90 - 0.99]	0.031	0.95	[0.91 - 1.00]	0.052	1.03	[0.98 - 1.08]	0.276	0.93	[0.88 - 0.98]	0.004	0.92	[0.88 - 0.97]	0.003
	Self-Reports of Health at Age 26															
Model 6	Global Self-Reported Health	0.96	[0.91 - 1.01]	0.109	0.97	[0.92 - 1.02]	0.244	1.02	[0.96 - 1.07]	0.541	0.92	[0.88 - 0.97]	0.004	0.92	[0.88 - 0.97]	0.001
Model 7	Physical Functioning	0.96	[0.91 - 1.01]	0.087	0.96	[0.92 - 1.01]	0.135	1.03	[0.98 - 1.08]	0.308	0.92	[0.87 - 0.97]	0.002	0.92	[0.87 - 0.96]	0.001
Model 8	Current or Past Medical Conditions	0.95	[0.90 - 1.00]	0.052	0.96	[0.92 - 1.01]	0.120	1.03	[0.98 - 1.08]	0.286	0.91	[0.87 - 0.96]	0.001	0.91	[0.86 - 0.96]	<0.001
Model 9	Family Medical History	0.95	[0.90 - 1.00]	0.056	0.95	[0.91 - 1.00]	0.062	1.04	[0.99 - 1.10]	0.150	0.91	[0.86 - 0.96]	<0.001	0.91	[0.87 - 0.96]	<0.001
Model 10	Multivariate (all covariates above)	0.96	[0.91 - 1.01]	0.147	0.97	[0.92 - 1.02]	0.273	1.00	[0.95 - 1.05]	0.928	0.95	[0.90 - 0.99]	0.045	0.95	[0.90 - 0.99]	0.048

All analyses controlled for sex. Values in bold are significant at the level $p<0.05$.

Table 8

Association between Age-26 Personality and Age-38 Poor Health, Poor Health Controlling for IQ, and Self-reported Poor Health

	Index of Poor Health			Index of Poor Health Controlling for IQ[1]			Self-reported Poor Health[2]		
Personality Trait	**IRR**	**[95% CI]**	**pvalue**	**IRR**	**[95% CI]**	**pvalue**	**IRR**	**[95% CI]**	**pvalue**
Extraversion	0.95	[0.90 - 1.00]	0.068	0.97	[0.92 - 1.02]	0.285	0.97	[0.95 - 0.99]	0.026
Agreeableness	0.96	[0.91 - 1.01]	0.092	0.98	[0.93 - 1.03]	0.390	0.97	[0.94 - 0.99]	0.007
Neuroticism	1.04	[0.99 - 1.09]	0.158	1.00	[0.95 - 1.06]	0.986	1.07	[1.04 - 1.09]	<0.001
Conscientiousness	0.91	[0.86 - 0.96]	0.001	0.93	[0.88 - 0.98]	0.007	0.96	[0.93 - 0.98]	0.001
Openness-to-Experience	0.91	[0.87 - 0.96]	0.001	0.96	[0.91 - 1.02]	0.204	0.97	[0.95 - 0.99]	0.019

All analyses controlled for sex. Values in bold are significant at the level $p<0.05$

[1] IQ scores were obtained for the Dunedin Study members when they were children (Moffitt, Caspi, Harkness, & Silva, 1993) and again at age 38. The table displays the association between age-26 personality and age-38 poor health controlling for childhood intelligence. Additional analyses controlling for IQ at age 38 resulted in the same pattern of effects (i.e. no statistical inferences were altered).

[2] Self-reported global health, rated on a 1-5 scale ranging from poor to excellent (Ware & Sherbourne, 1992). Scale was reverse coded so that a higher score equals poorer self-reported health

Table 9

Association between Age-32 Staff Ratings of Study Member Personality and Age-38 Poor Health

		Receptionist Ratings of Personality														
		Extraversion			**Agreeableness**			**Neuroticism**			**Conscientiousness**			**Openness-to-Experience**		
		IRR	[95% CI]	pvalue	IRR	[95% CI]	pvalue	IRR	[95% CI]	pvalue	IRR	[95% CI]	pvalue	IRR	[95% CI]	pvalue
Model 1	Bivariate Model	0.95	[0.90 - 0.99]	0.041	0.97	[0.92 - 1.02]	0.238	1.05	[0.99 - 1.11]	0.105	0.93	[0.88 - 0.97]	0.001	0.88	[0.84 - 0.92]	<0.001
Model 2	Controlling for Health at 26	0.96	[0.91 - 1.00]	0.076	0.95	[0.90 - 0.99]	0.049	1.05	[1.00 - 1.11]	0.073	0.93	[0.89 - 0.97]	0.001	0.90	[0.86 - 0.94]	<0.001
		Nurse Ratings of Personality														
Model 1	Bivariate Model	0.94	[0.89 - 0.99]	0.016	1.01	[0.96 - 1.06]	0.688	1.04	[0.99 - 1.10]	0.122	0.94	[0.89 - 0.99]	0.014	0.88	[0.83 - 0.93]	<0.001
Model 2	Controlling for Health at 26	0.96	[0.92 - 1.01]	0.114	0.99	[0.95 - 1.04]	0.805	1.05	[1.00 - 1.10]	0.045	0.94	[0.89 - 0.99]	0.011	0.91	[0.87 - 0.96]	<0.001

All analyses controlled for sex. Values in bold are significant at the level $p<0.05$.