HHS Public Access

Author manuscript

J Res Pers. Author manuscript; available in PMC 2017 June 23.

Published in final edited form as:

J Res Pers. 2017 February ; 66: 46–53. doi:10.1016/j.jrp.2016.12.006.

Personality and Frailty: Evidence From Four Samples

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Abstract

Frailty is a prevalent geriatric syndrome. Little is known about the psychological factors associated with this syndrome. Based on four large samples of older adults aged from 65 to 104 years old, the present study examined whether personality traits are related to frailty. High neuroticism, low conscientiousness, low extraversion, low openness and low agreeableness were related to higher frailty across samples. Longitudinal analysis conducted in one sample revealed that high neuroticism was associated with worsening frailty over an 8-year period. Higher frailty at baseline and over time was related to maladaptive personality changes. This study extends existing knowledge on the link between personality and health in older adults, by identifying the personality traits associated with frailty, a complex geriatric syndrome.

Keywords

Frailty; personality; aging

Frailty is a heterogeneous geriatric syndrome characterized by decreased physiological reserve and higher vulnerability to stressors (Fried et al., 2001). The core components of frailty include impaired physical function, such as slower gait speed and less strength, metabolic dysfunction that results in loss of muscle mass, and fatigue, low energy, and exhaustion (Buchman, Schneider, Leurgans, & Bennett, 2008; Fried et al., 2001). The prevalence of this syndrome increases with age, with up to half of individuals over 85 estimated as frail (Clegg, Young, Lliffe, Rikkert, & Rockwood, 2013). Individuals with frailty are at a greater risk of falls (Ensrud et al., 2007), limitations in activities of daily living (Nourhashémi et al., 2001), steeper cognitive decline (Boyle, Buchman, Wilson, Leurgans, & Bennett, 2010), Alzheimer's disease (Buchman, Boyle, Wilson, Tang, & Bennett, 2007; Buchman et al., 2008) and mortality (Buchman, Wilson, Bienias, & Bennett, 2009). Given these implications, the identification of factors associated with this syndrome is of crucial importance. Most attention has been directed toward the biological processes involved in frailty (Buchman et al., 2008; Buchman et al., 2014); less is known about how psychological variables are associated with it. There is, however, some evidence that links

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frailty or its components with psychological factors, such as positive affect, psychological well-being, and perceived control (e.g., Gale, Cooper, Deary, & Sayer, 2014; Infurna & Gerstorf, 2014; Park-Lee, Fredman, Hochberg, & Faulkner, 2009). Building on these findings, the present study examined whether personality traits are associated with an index of frailty.

Theoretical models of personality and health recognize that concurrent associations are likely the result of reciprocal relations between personality and health-related factors, such as frailty. To better identify the temporal relation between personality and frailty, we used longitudinal data to test whether (a) personality traits are risk factors for the incidence or worsening of frailty and (b) whether frailty predicts change in personality. The identification of the personality traits that are risk factors for frailty may inform about the characteristics of vulnerable individuals and may guide tailored risk-reducing interventions and behavioral programs. In addition, the association between frailty and change in personality in the very old is relevant to developmental theories of personality and can advance knowledge on the factors that are associated with personality trajectories in the later part of life.

According to the Five Factor Model (Digman, 1990), personality is defined by five traits: Neuroticism (the tendency to experience distress and anxiety), extraversion (the tendency to experience positive emotions and to be sociable), openness to experience (the tendency to be curious and to entertain new ideas), agreeableness (the tendency to be altruistic and cooperative) and conscientiousness (the tendency to be disciplined and thoughtful). Among these traits, high neuroticism and low conscientiousness have been robustly related to vulnerability to age-related declines in health (Canada, Stephan, Jaconelli, & Duberstein, 2016; Chapman, Duberstein, & Lyness, 2007; Suchy, Williams, Kraybill, Franchow, & Butner, 2010; Terracciano, Stephan, Luchetti, Gonzalez-Rothi, & Sutin, in press). Individuals with this personality profile have more functional limitations and steeper declines in physical functioning in old age (Canada et al., 2016 ; Krueger, Wilson, Shah, Tang, & Bennett, 2006 ; Terracciano et al., in press) and have less energy (Terracciano et al., 2013). Furthermore, high neuroticism has been related to being underweight (Terracciano et al., 2009). High neuroticism and low conscientiousness are also related to health-risk behaviors, such as smoking (Hakulinen et al., 2015) and physical inactivity and sedentary behavior (Rhodes & Smith, 2006; Sutin et al., 2016), as well as biological dysfunction (Luchetti, Barkley, Stephan, Terracciano, & Sutin, 2014; Stephan, Sutin, Luchetti, & Terracciano, 2016), that increase the risk of frailty in old age (Hubbard, O'Mahony, Savva, Calver, & Woodhouse, 2009; Kojima, Iliffe, & Walters, 2015; Peterson et al., 2009).

Despite mixed evidence for the association with morbidity and mortality (e.g., Jokela et al., 2013; Sutin, Zonderman, Ferrucci, & Terracciano, 2013), extraversion and openness may be potential correlates of frailty. Individuals who score lower on Extraversion and Openness, for example, are less likely to be physically active (Sutin et al., 2016), less energetic, and have lower cardiorespiratory fitness (Terracciano et al., 2013; Terracciano et al., in press). They are also more likely to experience functional limitations (Buchman et al., 2013; Tolea et al., 2012) and are more likely to suffer from greater disease burden in old age (Weston, Hill, & Jackson, 2015) compared to their more extraverted and open counterparts. In addition, low openness and extraversion have been associated with inflammation (Luchetti et

al., 2014) and physiological dysregulation (Stephan et al., 2016), respectively. These behavioral, health, and biological factors may lead to a higher risk of frailty in old age.

The objective of the present study was to test the association between the five major dimensions of personality and a frailty index in four large cohorts of older adults. Higher neuroticism and lower conscientiousness, extraversion, and openness were hypothesized to be related to greater frailty when measured concurrently. With longitudinal data from one of the cohorts, we also tested whether higher neuroticism and lower conscientiousness were related to increased frailty over an eight-year follow-up. These hypotheses were tested while controlling for demographic factors.

We conducted additional analyses to better understand the relation between personality and frailty. First, to examine whether the associations between personality and frailty were due to specific behaviors, we tested whether the association between personality and frailty persisted when controlling for smoking and physical activity. Second, consistent with some recent reports of healthy neuroticism (i.e., a beneficial effect of neuroticism on health-related outcomes when conscientiousness is high) (Turiano, Mroczek, Moynihan, & Chapman, 2013; Weston & Jackson, 2015), we tested for an interaction between neuroticism and conscientiousness on frailty. In addition, recent research revealed that age moderates the relation between personality and physical functioning, with stronger associations observed in old age (Canada et al., 2016). Therefore, we further examined whether the association between personality and frailty was moderated by age. Finally, to further test the robustness of the association between personality and frailty, we conducted sensitivity analyses in which the frailty index was computed without Body Mass Index (BMI) and by using a categorical instead of continuous measure of frailty.

In the longitudinal study, we also examined whether frailty was associated with the rate of change in personality. Higher disease burden, physiological dysregulation and performance based indicators of poor physical functioning have been related to maladaptive personality trajectories, such as relatively higher neuroticism and lower conscientiousness, extraversion, agreeableness and openness over time (Jokela, Hakulinen, Singh-Manoux, & Kivimäki, 2014; Mõttus, Johnson, Starr, & Deary, 2012; Mueller et al., in press; Stephan et al., 2016; Sutin et al., 2013). Therefore, based on these studies, higher level of and changes in frailty were expected to be associated with relatively higher neuroticism, and lower conscientiousness, extraversion, openness and agreeableness over time.

Method

Participants

Participants were drawn from the Wisconsin Longitudinal Study graduate (WLSG) sample, the Wisconsin Longitudinal Study Sibling (WLSS) sample, the National Health and Aging Trends Survey (NHATS), and the Health and Retirement Study (HRS). We only consider participants over 65 years old because the incidence of frailty increases in old age and is rare in younger individuals. Furthermore, in the NHATS and the HRS, frailty measures were available only for individuals aged 65 years and older.

The WLS is a study of 10317 participants who were born between 1937 and 1940 and who graduated from Wisconsin high schools in 1957. In addition to this main sample of high school graduates, the WLS has also collected data on a selected sibling of some of the graduates. The WLS sample is broadly representative of older, white, non-Hispanic Americans who have completed at least a high school education. The present study used data collected in 2011. Complete data on both personality and frailty components (i.e. walking speed, grip strength, BMI and fatigue), were obtained from 4138 individuals in the WLSG and from 1696 participants in the WLSS (see Table 1).

The NHATS is a nationally representative prospective cohort study of Medicare enrollees aged 65 years and older. Participants were first interviewed in 2011 and are re-interviewed annually (Kasper & Freedman, 2014). Frailty components were assessed at each wave; personality was first assessed in 2013 for one-third of the sample, and in 2014 for the second third. Data from these two waves were combined and used for the present study. The analyzed sample was composed of 2026 individuals aged 67 to 103 years who provided complete data on demographic, personality and frailty components (see Table 1).

The HRS is a nationally representative longitudinal study of adults aged 50 years and older. Starting in 2006, HRS implemented an enhanced face-to-face interview that included a psychosocial questionnaire with personality items, and measures of walking speed, grip strength, height, weight, and fatigue. Walking speed was measured only among respondents aged 65 years or older (Crimmins et al., 2013). Therefore, the study sample was composed of 3117 participants aged 65 years and older who provided complete data on measures of interest in 2006 (see Table 1). In addition, follow-up measures of frailty were available in the HRS (these measures were not available in the follow-up of the other three studies). Of the participants who had data at baseline, 1586 individuals also completed the frailty measures in 2014. This sample was used to examine the relation between personality and changes in frailty over time. The HRS also provided personality data at follow-up, which made it possible to examine the link between frailty and change in personality. Of the initial sample of 3117 individuals with complete data on frailty and personality at baseline, 1535 had complete personality data at follow-up, and 1294 had both frailty and personality data in 2014. Attrition analysis and descriptive statistics for the three longitudinal samples are presented in supplemental material (Table S1).

Measures

Personality—In the HRS, the Midlife Development Inventory (MIDI; Lachman & Weaver, 1997) was used to measure personality using 26 adjectives that assessed Neuroticism Extraversion, Openness, Agreeableness, and Conscientiousness. Participants were asked how much each adjective described themselves on a scale ranging from 1 (*not at all*) to 4 (*a lot*). A shorter 10-item version of the MIDI was used in the NHATS, with each trait assessed with two adjectives on the same 4-point scale. A 29-item version of the Big Five Inventory (John, Donahue, & Kentle, 1991) was used in the WLSS and WLSG. Participants were asked whether they agreed or disagreed with descriptive statements that assess the five traits using a 6-point rating scale, ranging from 1 (*disagree strongly*) to 6 (*agree strongly*). Cronbach alphas ranged from .58 (openness) to .76 (extraversion) in the WLSS, from .61

(openness) to .75 (extraversion and neuroticism) in the WLSG, and from .65 (conscientiousness) to .78 (openness and agreeableness) in the HRS.

Frailty—In each sample, a composite measure of frailty was computed as in previous research (Boyle et al., 2010; Bushman et al., 2008, 2009, 2014). This measure included walking speed, grip strength, body composition, and fatigue (see Bushman et al., 2009). Walking speed was measured using a timed walk of 3 meters in the NHATS and 2.50 meters in the HRS and the WLS. Handgrip strength was measured in kilograms using a dynamometer. Two trials were recorded for each hand in the HRS and for the dominant hand in the WLS and the NHATS. The best performance across all trials was used for both walking speed and grip strength. Body mass index (BMI) was based on self-reported measures of height and weight in the NHATS and staff-assessed measurements in the HRS and the WLS. Consistent with prior studies (Bushman et al., 2008, 2009, 2014), fatigue was assessed using two questions from the Center for Epidemiologic Studies-Depression (CES-D) scale in the WLS and the HRS. In the WLS, the two questions asked on how many days during the last week individuals felt that everything they did was an effort and whether they could not get going. Answers ranged from 0 for none to 7 for everyday in the past week. These responses were recoded to 0 for none and 1 for at least one day in the past week. The same items were used in the HRS, except that individuals were asked whether or not they had experienced these symptoms much of the time in the past week, using a yes/no format. In the WLS and the HRS, answers were summed to give a fatigue score, ranging from 0 to 2. In the NHATS, participants were asked whether they had low energy or were easily exhausted during the last month using a yes/no format single item.

Frailty scores were computed based on validated methodology from previous research (Boyle et al., 2010; Bushman et al., 2008, 2009, 2014). Specifically, raw scores from walking speed, grip strength, and BMI were reversed so that higher values indicated poorer performance and lower body mass. The scores of each component were then z-scored and summed to give a frailty index; higher scores indicated higher frailty. In the HRS, the same procedure was followed for computing frailty at follow-up. Raw scores were standardized using baseline mean and SD of frailty. The test-retest correlation between the index at baseline and follow-up was .62 (p <.001).

Covariates—Age (in years), sex (coded as 1 for men and 0 for women), and educational level were included as covariates. Education was measured on a scale ranging from 1 (*No schooling completed*) to 9 (*Master's, professional or doctoral degree*) in the NHATS, whereas it was reported in years in the WLS and the HRS. Race (coded as 1 for black and 0 for other) and ethnicity (coded as 1 for Hispanic and 0 for not Hispanic) were also controlled for in the HRS and the NHATS. In additional analysis, physical activity and smoking were included as covariates. Physical activity was assessed with items on the frequency and/or quantity of moderate and/or vigorous physical activity. In the WLSG, the WLSS and the NHATS, smoking was coded as 1 (current smoker) and 0 (never/former smoker), whereas it was coded as 1 (current/former smoker) and 0 (never smoker) in the HRS.

Data analysis

Regression analyses were conducted to examine the association between personality traits and frailty. In each sample, frailty was regressed on personality, controlling for the demographic factors. Separate analyses were conducted for each trait and with all traits entered simultaneously in the same analysis. In each sample, personality traits were z-scored. To provide a quantitative synthesis of the findings across the four samples, we combined the effect estimates from each study in a random-effects meta-analysis, a conservative approach compared to a fixed-effect meta-analysis. Heterogeneity was assessed with the Q statistic. The meta-analysis was performed using the Comprehensive Meta-Analysis software. In additional analyses, we tested whether age moderated the personality-frailty association, whether there was an interaction between neuroticism and conscientiousness, and whether the associations remained significant after adjusting for physical activity and smoking and with an alternate operationalization of frailty.

Regression analyses were conducted in the HRS predicting follow-up frailty from baseline personality, controlling for demographic factors and baseline frailty. In the analysis, each trait was examined separately and then simultaneously. Regression was also used to test whether baseline frailty was associated with change in personality. Each trait at follow-up was predicted from baseline frailty, controlling for age, sex, race, ethnicity, and baseline personality. Finally, the relation between change in frailty and change in personality traits was examined using partial correlations between residual change scores for frailty and each personality trait, controlling for the covariates.

Results

Descriptive statistics for the four samples are presented in Table 1. As expected, the results suggested that higher neuroticism and lower conscientiousness, extraversion and openness were related to higher frailty, controlling for the demographic factors (Table 2). This pattern was found in all samples except in the NHATS, where no association was found between conscientiousness and the frailty index. Lower agreeableness was also associated with higher frailty in all samples (Table 2). The associations were generally stronger in the WLS samples and weaker in the NHATS. The meta-analysis confirmed that higher neuroticism and lower conscientiousness, extraversion, openness and agreeableness were associated with higher frailty (see Table 2).

We conducted several additional analyses to further evaluate the concurrent association between personality and frailty. First, we tested regression models with the five traits entered simultaneously to evaluate to what extent the association of each trait with frailty was independent from the other personality traits. We found that higher neuroticism, lower extraversion and lower conscientiousness were consistently associated with higher frailty in the WLSG, the WLSS, and the HRS, whereas only neuroticism remained a significant predictor in the NHATS (see supplemental Table S2). Second, we tested and found that the associations between personality and frailty remained significant across the four samples when physical activity and smoking were included as additional covariates (see Supplemental Tables S3–S6). Third, we examined whether there was an interaction between neuroticism and conscientiousness in predicting frailty. A significant interaction emerged

only in the HRS ($\beta_{interaction}$= −.03, p<.05). However, in contrast to the idea of healthy neuroticism (Turiano et al., 2013; Weston & Jackson, 2015), we found that the association between neuroticism and higher frailty is slightly reduced when conscientiousness is high. No significant interaction was found in the other samples. Fourth, we tested age as a moderator and found that the relation between lower extraversion and higher frailty was more pronounced among older individuals in the HRS ($\beta_{interaction}$= −.03, p<.05), whereas it was stronger among younger individuals in the NHATS ($\beta_{interaction}$= .04, p<.05). Age did not moderate any of the other relations between personality and frailty. Fifth, we tested whether the association between personality and frailty changed when BMI was excluded from the index. The overall pattern of associations remained mostly unchanged in the four samples, with some notable exceptions: conscientiousness became a significant predictor of frailty in both the NHATS and the HRS. Higher conscientiousness was related to lower frailty in the NHATS (β= −.06, p<.01) and to a steeper decline in frailty over time in the HRS (β= −.07, p<.001) and extraversion and agreeableness were no longer associated significantly with frailty in the NHATS when BMI was excluded from the index. Sixth, in supplemental analyses we examined whether personality was associated with a categorical measure of frailty. The overall pattern of results remained unchanged (see supplemental Tables S7 and S8).

The longitudinal analysis in the HRS indicated that higher baseline neuroticism and lower baseline extraversion, openness and conscientiousness were prospectively associated with higher frailty at follow-up (Table 3). Only higher neuroticism was related to an increase in frailty over the 8-year period in the HRS, controlling for the covariates (Table 3). In contrast to our expectations, conscientiousness was unrelated to change in frailty. When all traits were included simultaneously, neuroticism remained associated with higher frailty over time, indicating that the effect of neuroticism was independent from the other traits.

A final set of analyses examined the link between frailty level and changes and change in personality. Regression analysis revealed that frailty at baseline was associated with higher neuroticism and lower agreeableness over time (Table 4). Partial correlations between the residuals further showed that higher frailty over time was related to increases in neuroticism and declines in extraversion, openness, agreeableness and conscientiousness over time (Table 4).

Discussion

Based on data from more than 10,000 individuals aged 65 years and older, the present study found that personality is related to frailty. All five personality traits were concurrently associated with frailty, with the most robust evidence found for neuroticism. High neuroticism was further related to a steeper worsening of frailty over 8 years. The associations were independent of age, other demographic variables, smoking and physical inactivity, and were similar across continuous and categorical indices of frailty. In addition, higher frailty at baseline and over time was associated with maladaptive personality trajectories over 8 years, with increasing neuroticism and decreasing conscientiousness, extraversion, openness and agreeableness. As a whole, this study extends current knowledge

on the relation between personality and health in old age by providing evidence of an association between personality traits and a highly prevalent geriatric syndrome.

As expected, higher neuroticism and lower conscientiousness, extraversion and openness were related to concurrent frailty. This finding is consistent with other evidence for links between a vulnerable personality profile and worse health in old age (Suchy et al., 2010; Weston et al., 2015) and extends previous studies that found associations with physical limitations, disability and lower energy among older adults (Canada et al., 2016; Krueger et al., 2006; Terracciano et al., 2013). The relation between personality traits and frailty may reflect a lifetime of health-damaging behaviors associated with these traits, such as smoking and physical inactivity (Hakulinen et al., 2015; Rhodes & Smith, 2006; Sutin et al., 2016). These risky behaviors may have cumulative consequences across the lifespan that result in worse physical functioning, mobility limitations, and lower muscle mass in old age. However, we found that the associations between personality and frailty hold even after accounting for these health-risk behaviors. Biological processes may also act in this association. Frailty is characterized by a decline in physiological reserve (Fried et al., 2001), and high neuroticism and low conscientiousness, extraversion and openness have been associated with lower cardiorespiratory fitness (Terracciano et al., 2013), more inflammation (Luchetti et al., 2014 ; Sutin et al., 2010) and greater allostatic load (Stephan et al., 2016). As a result, more emotionally vulnerable and less conscientious, extraverted and open individuals may be more at risk of frailty in part because of limited physiological resources. The present study revealed an unexpected associations between lower agreeableness and higher frailty. Individuals low in agreeableness are more likely to engage in health-risk behaviors across the lifespan such as smoking (Terracciano & Costa, 2004) and heavy alcohol consumption (Hakulinen et al., 2015), which may culminate in higher frailty in old age. The association between agreeableness and health conditions/outcomes is often mixed, and more research is needed to confirm the association observed in this study.

Neuroticism was consistently related to frailty across samples in the cross-sectional analyses and to greater frailty over time in the longitudinal analysis. In contrast, the relation between conscientiousness and frailty was less consistent. This association was found in three out of four samples, and conscientiousness was not related to changes in frailty. One explanation could be related to the use of body composition, including weight loss and low BMI, as one of the defining criteria of frailty. Lower conscientiousness is related consistently to being overweight and obese (Allen, Vella, Swann, & Laborde, in press). These differential relations with specific criteria may explain why the overall frailty-related risk associated with low conscientiousness, may be lower or less consistent than for higher neuroticism in this study. Consistent with this hypothesis, additional analyses without BMI included as a criteria revealed a significant association between conscientiousness and both lower frailty at baseline in the NHATS (as well as the other three samples) and over time in the HRS.

Frailty could be an intermediate factor that contributes to the relation between personality and health and longevity in old age. Individuals with frailty tend to have steeper declines in cognition and are at greater risk of Alzheimer’s disease (Boyle et al. 2010; Buchman et al., 2007, 2008) and premature mortality (Buchman et al., 2009). Personality traits such as higher neuroticism and lower conscientiousness are also risk factors for Alzheimer’s disease

(Terracciano et al., 2014) and mortality (Jokela et al., 2013). Thus, the higher frailty of individuals higher in neuroticism and lower in conscientiousness could be an intermediate manifestation of their risk of cognitive decline and mortality.

This study was guided by a dynamic model that hypothesized the bidirectional associations between personality and frailty. The results of the longitudinal analyses were consistent with the expectation that frailty may be associated with change in personality. The results revealed that higher frailty at baseline and over an 8-year period were associated with maladaptive personality trajectories, characterized by undesirable changes on all five factors. This relation may operate through physiological, behavioral and health-related pathways. Frailty is characterized by decreased physiological reserve (Fried et al., 2001), and is related to higher physiological dysregulation (Gruenewald, Seeman, & Karlamangla, & Sarkisian, 2009). Recent research has found that physiological dysregulation across systems may have an impact on personality, manifested into a lower propensity to be energetic and enthusiastic, to be self-disciplined and organized, open to new ideas, and agreeable over time (Stephan et al., 2016). Further, higher frailty limits activities of daily living (Nourhashémi et al., 2001), which may foster physical inactivity. A physically inactive lifestyle is associated with lower extraversion, openness, agreeableness, conscientiousness and higher neuroticism over time (Allen, Vella, & Laborde, 2015; Stephan, Sutin & Terracciano, 2014). Finally, higher frailty is associated with higher vulnerability to worse health outcomes (Ensrud et al., 2007) that have been related to maladaptive personality changes (Jokela et al., 2014; Sutin et al., 2013). Thus, this study identifies a new health-related factor associated with personality development in older age. It also contributes to existing knowledge on the implications of frailty. Indeed, the present study adds personality change to the list of outcomes associated with higher frailty.

From a clinical perspective, personality assessment could help identify individuals at higher risk of frailty who may benefit from targeted interventions. Behavioral interventions tailored to individuals' personality may increase adherence and frailty risk. Individuals higher in neuroticism and lower in conscientiousness, extraversion, and openness are more likely to engage in behaviors that increase risk for frailty, such as physical inactivity and smoking. Thus, interventions directed toward changing such behaviors may be useful to reduce their frailty risk, for example through structured supervised physical activity and exercise programs and smoking cessation interventions. In addition, such programs may also directly promote the development of more adaptive, resilient personality profiles over time. Indeed, a physically active lifestyle has been associated with lower neuroticism and higher extraversion, conscientiousness, agreeableness and openness over time (Allen et al., 2015; Stephan et al., 2014). Not smoking is related to higher conscientiousness and agreeableness over time compared to smoking behavior (Allen et al., 2015), and smoking cessation is related to decreases in neuroticism (Littlefield & Sher, 2012). In turn, it is likely that such personality changes may be accompanied by lower frailty risk over time. The present observational study also suggests that reduced frailty may be related to lower neuroticism and higher conscientiousness, extraversion, openness and agreeableness over time. Intervention research is now needed to test whether interventions that reduce frailty also lead to adaptive personality changes. As a whole, the present research can help in the design of

prevention and treatment options that consider personality differences in an effort to attenuate loss of autonomy and decline in quality of life in old age.

The present study has several strengths, including the use of four large samples of older adults and examining both concurrent and prospective associations between personality and frailty. The large sample sizes provided sufficient power (>80%) to detect even small effect sizes. Furthermore, supplemental analysis revealed that the overall pattern of findings remained unchanged across the four samples when using a categorical measure of frailty. However, there are some limitations that need to be considered. The observational study design limits the possibility of determining causal relations. Although personality is likely to be a risk factor for frailty, it is also likely that frailty may cause personality change, as indicated by the longitudinal findings. It is also possible that the development of frailty and maladaptive personality change have a shared etiology and are manifestations of a common pathologic process. In addition, although validated, the measures of personality were very brief. The internal consistency of some personality scales was relatively low (e.g., .58). Results for these scales should be interpreted with caution, but internal consistency tends to be a poor indicator of personality scale validity (McCrae, Kurtz, Yamagata, & Terracciano, 2011). In addition to the issue of reliability, such measures do not allow for a detailed examination of the personality facets associated with frailty. Finally, the strength of the association between personality traits and the frailty index is relatively small in absolute terms. However, frailty is a heterogeneous, complex, and multi-determined syndrome that is associated with a variety of factors from biological to environmental. Therefore, any individual factor, including personality, is unlikely to have a strong association with this composite measure. In addition, personality may be a distal predictor of frailty that acts through more proximal behavioral and biological processes.

Despite these limitations, the present study provides robust evidence that personality traits are associated with frailty in old age. In particular, a higher propensity to experience stress and negative emotions is related to higher concurrent and worsening physical frailty over time. A reciprocal relation is likely to exist, such that frailty may be manifested in maladaptive personality change over time. Therefore, this study paves the way for more research aiming to identify the psychological underpinnings of geriatric conditions.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Since 1991, the WLS has been supported principally by the National Institute on Aging (AG-9775, AG-21079, AG-033285, and AG-041868), with additional support from the Vilas Estate Trust, the National Science Foundation, the Spencer Foundation, and the Graduate School of the University of Wisconsin-Madison. Since 1992, data have been collected by the University of Wisconsin Survey Center. More information about both WLS samples and how to access the data can be found here: http://www.ssc.wisc.edu/wlsresearch/. The NHATS is sponsored by the National Institute on Aging (grant number NIA U01AG032947) through a cooperative agreement with the Johns Hopkins Bloomberg School of Public Health. More information about NHATS and how to access the data can be found here: http://www.nhats.org/. The HRS is sponsored by the National Institute of Aging (grant number NIA U01AG009740) and conducted by the University of Michigan. More information about HRS and how to access the data can be found here: http://hrsonline.isr.umich.edu/index.php.

This work was supported by the National Institute on Aging Grant R03AG051960 to Antonio Terracciano and Angelina Sutin.

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Table 1

Characteristics of the Samples

	WLSG		WLSS		HRS		NHATS	
Variables	***M/%***	***SD***	***M/%***	***SD***	***M/%***	***SD***	***M/%***	***SD***
Age (Years)	71.18	0.90	71.74	4.94	74.04	6.82	78.94	7.26
Sex (% women)	54%	-	53%	-	55%	-	56%	-
Race (% black)	-	-	-	-	9%	-	17%	-
Ethnicity (% hispanic)	-	-	-	-	5%	-	4%	-
Education[1]	13.87	2.40	14.08	2.60	12.67	2.93	5.41	2.26
Frailty[2]	0.00	2.05	0.00	2.16	0.00	2.30	0.43	1.922
Neuroticism[3]	3.01	0.92	3.01	0.93	1.99	0.57	2.19	0.83
Extraversion[3]	3.80	0.86	3.76	0.88	3.22	0.53	3.17	0.73
Openness[3]	3.46	0.76	3.45	0.73	2.92	0.53	2.86	0.80
Agreeableness[3]	4.81	0.71	4.82	0.70	3.53	0.46	3.59	0.50
Conscientiousness[3]	4.76	0.70	4.73	0.72	3.35	0.46	3.27	0.69

Note. WLSG: N= 4138; WLSS: N= 1696; HRS: N= 3117; NHATS: N= 2026

[1]Education was reported in years in the WLS and the HRS, whereas it was measured on a scale ranging from 1 (*No schooling completed*) to 9 (*Master's, professional or doctoral degree*) in the NHATS

[2]Sum of z-scores of walking speed, grip strength, BMI, and fatigue. A yes (1) or no (0) format was used in the NHATS for the measure of fatigue, and added to the z-scores of the other components.

[3]Personality was assessed using a 6-point rating scale in the WLSG and WLSS, and a 4-point scale in the HRS and the NHATS

Table 2

Summary of Regression Analysis Predicting Frailty from Personality

	WLSG[a]	WLSS [a]	HRS [b]	NHATS [b]	Random Effect	Heterogeneity Q
Neuroticism	.20*** (.173; .228)	.19*** (.154;.234)	.16*** (.131;.188)	.10*** (.064;.139)	0.18*** (.137;.215)	13.16**
Extraversion	−.11*** (−.142; −.087)	−.14*** (−.177; −.097)	−.14*** (−.165; −.108)	−.06** (−.098; −.024)	−0.13*** (−.171; −.093)	12.82**
Openness	−.07*** (−.099; −.040)	−.06** (−.103; −.016)	−.08*** (−.112; −.053)	−.05** (−.092; −.017)	−0.08*** (−.095; −.057)	2.08
Agreeableness	−.09*** (−.118; −.061)	−.08*** (−.122; −.040)	−.06*** (−.087; −.028)	−.05* (−.083; −.008)	−0.08*** (−.099; −.060)	3.38
Conscientiousness	−.12*** (−.149; −.095)	−.16*** (−.199; −.120)	−.09*** (−.123; −.065)	−.01 (−.050;.025)	−0.11*** (−.175; −.051)	31.97***

Note. WLSG: N= 4138; WLSS: N= 1696; HRS: N= 3117; NHATS: N=2026

Coefficients are standardized regression coefficients. 95% confidence intervals are in parentheses

[a]Adjusted for age, sex, and education.

[b]Adjusted for age, sex, education, race and ethnicity

* $p < .05$,

** $p < .01$;

*** $p < .001$.

Table 3

Regression Analysis Predicting Follow-up Frailty from Baseline Personality in the HRS (N= 1586)

	Follow-up Frailty[a]		Frailty Change[b]	
	Model 1[c]	***Model 2***[e]	***Model 1***[d]	***Model 2***[e]
Neuroticism	0.13 *** (.087;.171)	0.12 *** (.074;.161)	0.07 *** (.034;.109)	0.07 *** (.031;.108)
Extraversion	−0.06 ** (−.103; −.019)	−0.03 (−.081;.030)	−0.01 (−.044;.030)	0.02 (−.028;.070)
Openness	−0.05 * (−.097; −.009)	−0.01 (−.063;.041)	−0.02 (−.059;.018)	−0.01 (−.057;.035)
Agreeableness	−0.04 (−.082; .006)	0.00 (−.051; .058)	−0.01 (−.052;.025)	−0.01 (−.057; .040)
Conscientiousness	−0.06 ** (−.103; −.019)	−0.03 (−.074;.021)	−0.03 (−.066;.008)	−0.02 (−.059;.025)

Note. N= 1586; Coefficients are standardized regression coefficients. 95% confidence intervals are in parentheses.

* $p < .05$,

** $p < .01$,

*** $p < .001$

[a] Regression analysis predicting follow-up frailty without controlling for baseline frailty

[b] Regression analysis predicting follow-up frailty controlling for baseline frailty

[c] Adjusted for age, sex, education, race and ethnicity.

[d] Adjusted for age, sex, education, race, ethnicity, and baseline frailty.

[e] Model 2 includes Model 1 covariates and all five Traits.

Table 4

Summary of Analysis on the Association between Baseline and Changes in Frailty and Personality Change (N= 1535)

	Neuroticism β(95%CI)	Extraversion β(95%CI)	Openness β(95%CI)	Agreeableness β(95%CI)	Conscientiousness β(95%CI)
Sex	−.01 (−.054;.038)	−.03(−.072;.017)	−.05*(−.092; −.007)	−.09***(−.142; −.045)	−.05*(−.095; −.002)
Age	.02 (−.021;.063)	−.10***(−.143; −.062)	−.06**(−.099; −.020)	−.08***(−.124; −.039)	−.11***(−.148; −.063)
Education	−.04*(−.087; −.003)	.04 (−.000;.079)	.09***(.046;.126)	.03 (−.010;.073)	.07***(.033;.117)
Race	−.05*(−.091; −.010)	.00 (−.035; .042)	.00 (−.035; .040)	−.03 (−.068;.013)	.00 (−.038;.043)
Ethnicity	−.04 (−.077;.005)	−.00 (−.040;.037)	.03 (−.009;.067)	.01 (−.028; .055)	.01 (−.029; .053)
Baseline Personality	.57***(.534;.616)	.64***(.600;.677)	.63***(.596;.674)	.57***(.530;.614)	.58***(.537;.618)
Baseline Frailty	.09***(.039;.138)	−.01 (−.053;.040)	−.03 (−.080;.010)	−.06*(−.110; −.012)	−.02 (−.068;.029)
Correlated Change between Frailty and Personality[a]	.11***	−.13***	−.11***	−.07*	−.13***

Note: β = Standardized Regression Coefficients. 95%CI= 95% confidence intervals

* $p < .05$,

** $p < .01$,

*** $p < .001$

[a]Partial correlations controlling for age, sex, education, race, and ethnicity (N= 1294)