Original Research Article

Journal of Aging and Health
2024, Vol. 0(0) 1–13

DOI: 10.1177/08982643241296995
journals.sagepub.com/home/jah
Sage

Personality and Markers of Lower Extremity Function: Findings From Six Samples

Yannick Stephan, PhD[1], Angelina R. Sutin, PhD[2], Brice Canada, PhD[3], André Hajek, PhD[4], Tiia Kekäläinen, PhD[5], and Antonio Terracciano, PhD[6]

Abstract

Objectives: This study investigated the associations between Five-Factor Model personality traits and balance impairment and lower limb strength. **Methods:** Middle-aged and older adults (Age range: 34–104 years; *N* >27,000) from six large samples from the US and England were assessed for standing balance, lower limb strength, personality traits, sociodemographic, and health-related variables. **Results:** Higher extraversion, openness, agreeableness, and conscientiousness were related to lower balance impairment risk and better lower limb strength. Higher neuroticism was associated with higher risk of balance impairment and with weaker lower limb strength. Biological, clinical, behavioral, and psychological factors partially accounted for these associations between personality and risk of balance impairment. Depressive symptoms and physical activity partially mediated the associations between personality traits and limb strength. **Discussion:** Personality traits have replicable associations with lower extremity functions. The study identifies potential moderators and mediators of these associations.

Keywords

personality, balance, muscle strength

Introduction

Lower extremity function is critical for older adults' quality of life and health. Indeed, it is a key factor for mobility, which in turn is crucial for maintaining community independence in old age (Rantakokko et al., 2013). Worse performance on objective measures of lower extremity function, such as slower gait speed, balance impairment, and weaker lower limb strength, have been implicated in an increased risk of limitations in activities of daily living (ADL) (Wang et al., 2020), falls (Welch et al., 2021), cognitive impairment (Veronese et al., 2016), hospitalization (Volpato et al., 2011), and all-cause mortality (Pavasini et al., 2016; Volpato et al., 2011). Therefore, identifying the factors associated with lower extremity function could inform interventions to promote mobility and health among older adults. A range of clinical and behavioral factors have been found to contribute to worse lower extremity function, such as higher body mass index (BMI), chronic conditions, and physical inactivity (Lucena Germano et al., 2023; Rundel et al., 2021; Stathi et al., 2022). Comparatively less is known about the association between psychological factors, such as personality traits, and lower extremity function.

Personality traits are enduring patterns of thoughts, feelings, and behaviors (Costa et al., 2019). Five-Factor Model personality traits (FFM, McCrae & John, 1992) consistently predict overall health across adulthood (Luo et al., 2023; Strickhouser et al., 2017; Wright et al., 2023). Several studies also provided evidence of an association between personality and markers of physical function (Bos et al., 2023; Hajek & König, 2021; Mueller et al., 2018; Stephan et al., 2022a, 2023a; Terracciano et al., 2013). Specifically, higher neuroticism (the propensity toward negative emotionality and distress) has been related to worse performance on measures of physical functioning, such as lower grip strength (Mueller et al., 2018; Stephan et al., 2022b), lower peak

[1]Euromov, University of Montpellier, Montpellier, France
[2]Department of Behavioral Sciences and Social Medicine, College of Medicine, Florida State University, Tallahassee, FL, USA
[3]L-Vis, University Lyon 1, Villeurbanne, France
[4]Department of Health Economics and Health Services Research, Hamburg Center for Health Economics, University Medical Center Hamburg-Eppendorf, Hamburg, Germany
[5]Laurea University of Applied Sciences, Vantaa, Finland
[6]Department of Geriatrics, College of Medicine, Florida State University, Tallahassee, FL, USA

Corresponding Author:
Yannick Stephan, Euromov, University of Montpellier, UFRSTAPS, 700, Avenue du Pic St Loup, Montpellier 34090, France.
Email: yannick.stephan@umontpellier.fr

expiratory flow (Stephan et al., 2023a; Terracciano et al., 2017), and lower aerobic capacity (Terracciano et al., 2013). Higher extraversion (the propensity toward positive emotionality and activity), openness (the propensity toward curiosity and imagination), and conscientiousness (the propensity to self-discipline and responsibility) have been associated with better grip strength (Stephan et al., 2022a), higher peak expiratory flow (Stephan et al., 2023b; Terracciano et al., 2017), and higher aerobic capacity (Terracciano et al., 2013). There is less consistent association between agreeableness and markers of physical function (Stephan et al., 2022a; Terracciano et al., 2013).

The examination of the association between personality and lower extremity function is critical for a better understanding of the potential mechanisms through which personality is related to crucial age-related outcomes, such as falls (Canada et al., 2020) and limitations in ADL/IADL (Canada et al., 2021; Hajek & König, 2021). Research on the link between personality and lower extremity function has focused on gait speed. Studies revealed replicable associations between higher neuroticism and slower gait speed, whereas higher extraversion, openness, and conscientiousness were associated with faster gait speed (Kekalainen et al., 2020; Stephan et al., 2018; Terracciano et al., 2013; Tolea et al., 2012). Less is known about the association between personality, standing balance, and lower limb strength (Tolea et al., 2012). Despite limitations in causal interpretation, such an association could be expected for several reasons. Indeed, the consistent link between personality traits and gait speed (Kekalainen et al., 2020; Stephan et al., 2018; Terracciano et al., 2013) and muscle strength (Stephan et al., 2022b) suggests that they may be related to standing balance and lower limb strength. In addition, higher neuroticism and lower extraversion, openness, and conscientiousness have been associated with an increased likelihood of frailty (Bos et al., 2023; Gale et al., 2017; Hajek et al., 2021; Stephan et al., 2017), which is related to balance impairment and poorer lower limb strength. Furthermore, theoretical models of personality and health suggest that the traits are associated with health-outcomes through a range of biological, behavioral, psychological, and clinical pathways (Chapman et al., 2014; Grogan et al., 2023; Turiano et al., 2015). Therefore, it is likely that personality may be related to factors that are implicated in lower extremity function. For example, higher neuroticism, lower extraversion, openness, and conscientiousness are associated with higher inflammation (Luchetti et al., 2014; Stephan et al., 2024), physical inactivity (Sutin et al., 2016), depressive symptoms (Hakulinen et al., 2015), obesity (Vainik et al., 2019), and chronic conditions (Strickhouser et al., 2017; Wright et al., 2023) that may lead to balance impairment and poorer lower limb strength (Lucena Germano et al., 2023; Rundel et al., 2021; Stathi et al., 2022; Tuttle et al., 2020). In support of these theoretical assumptions, higher neuroticism and lower extraversion, openness, and conscientiousness have been associated with markers of worse physical function, such as lower grip strength through their link with inflammation, physical inactivity, and depressive symptoms (Stephan et al., 2022a). Such mechanisms are likely to have a similar role in lower extremity function.

Using six samples of middle-aged and older adults, the present research examines the association between personality traits and two markers of lower extremity function: standing balance and lower limb strength. The coordinated analysis of several samples tests the replicability and generalizability of these associations across samples with different sociodemographic characteristics and assessment methods. It was hypothesized that higher neuroticism would be related to worse balance and weaker lower limb strength, whereas higher extraversion, openness, and conscientiousness were expected to relate to better balance and better lower limb strength, given the broader literature on personality and physical function (Bos et al., 2023; Hajek et al., 2021; Mueller et al., 2018; Stephan et al., 2017, 2023b; Terracciano et al., 2013). No predictions were made for agreeableness. In line with recent research on factors that mediate the relation between personality and markers of physical function (Stephan et al., 2022b), additional analyses examined whether the associations between personality and both balance and lower limb strength were mediated by biological (c-reactive protein; CRP), behavioral (physical activity), clinical (disease burden, BMI), and psychological (depressive symptoms) factors (see Figure 1). Given previous sex-specific findings and studies focused on specific age groups (Tolea et al., 2010), exploratory analyses tested age and sex as moderators. It is possible that the associations between personality and functional parameters could partly reflect underlying neurodegenerative processes (such as Alzheimer's or Parkinson's disease) that can lead to personality change as well as loss of function. Such changes would likely be more common in older participants, suggesting a moderating role of age with strengthening associations in older participants.

Methods

Participants

Six samples were included: The Health and Retirement Study (HRS), the English Longitudinal Study of Ageing (ELSA), the National Health and Aging Trends Study (NHATS), the Midlife in the United States Study (MIDUS), the National Social Life, Health, and Aging Project (NSHAP), and the Wisconsin Longitudinal Study (WLS). Balance measures were available in the HRS, ELSA, and NHATS, and lower limb strength was available in the MIDUS, ELSA, NSHAP, WLS, and NHATS. For each sample, we selected the first available wave with measures of both personality and lower extremity function. Only participants with complete data on personality traits, demographic factors, and lower extremity function were included. Table 1 includes descriptive statistics for the six samples.

HRS is a nationally representative cohort study of Americans aged 50 years and older. Baseline personality, demographic, and balance data were obtained in 2006 for half the sample and in 2008 for the other half. A total of 12656 individuals had complete demographic and personality data. Within this sample, 1819 did not have data on balance, resulting in a final sample of 10837 participants (58% women; Mean Age = 68.21; SD = 9.68). HRS data can be accessed at https://hrs.isr.umich.edu/data-products.

ELSA is a nationally representative study of people aged over 50 years in England. Personality data were obtained at Wave 5 (2010/2011) and balance and lower limb strength were assessed at Wave 6 (2012/2013). Complete data on personality and demographic factors were obtained from 8117 participants. Of this sample, 2927 participants had missing data on lower limb strength. The final sample had 5190 individuals with complete data on personality, demographic factors, balance, and lower limb strength (55% women; Mean Age = 65.67; SD = 7.82). ELSA data can be accessed at https://www.ukdataservice.ac.uk/.

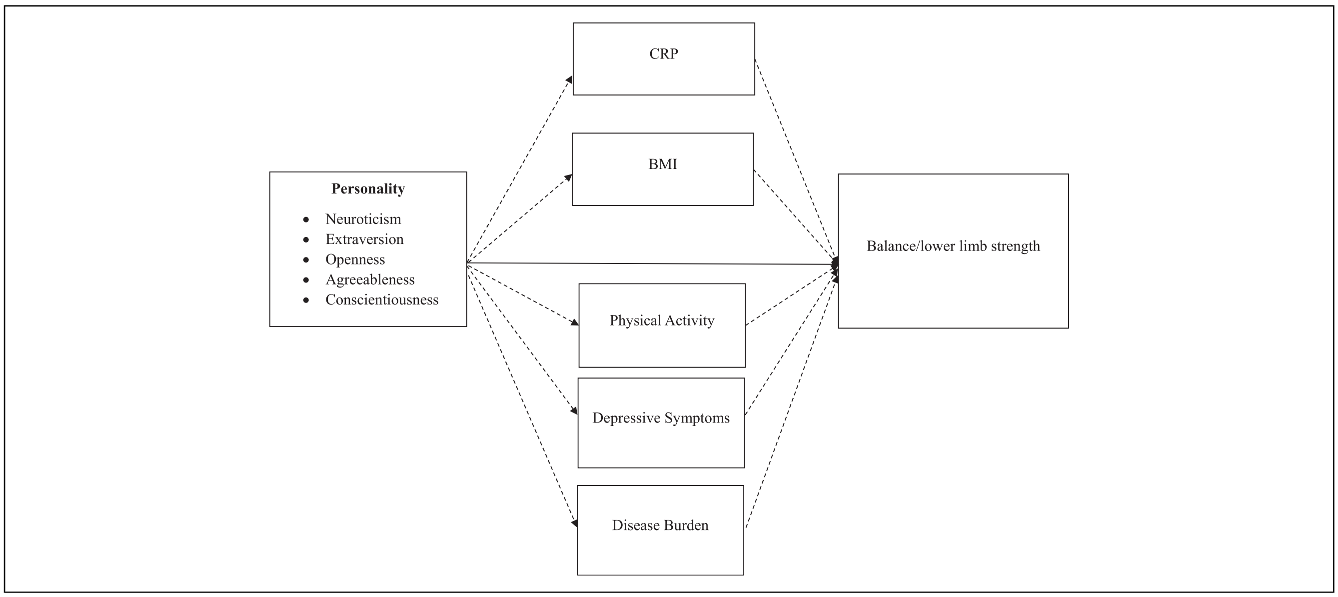

Figure 1. Conceptual mediational model of the relationship between personality and balance impairment and lower limb strength.

Table 1. Descriptive Statistics for the Six Samples.

	HRS		ELSA		NHATS		MIDUS		WLS		NSHAP	
Variables	*M/%*	*SD*	*M/%*	*SD*	*M/%*	*SD*	*M/%*	*SD*	*M/%*	*SD*	*M/%*	*SD*
Age (Years)	68.21	9.68	65.67	7.82	77.96	6.92	55.06	11.60	70.42	4.05	71.79	6.77
Sex (% women)	58%	-	55%	-	55%	-	54%	-	53%	-	52%	-
Race (% African American/Black)	10%	-	2%[a]	-	17%	-	3%	-	0%	-	10%	-
Ethnicity (% Hispanic)	7%	-	-	-	5%	-	-	-	0%	-	7%	-
Education	12.92	2.89	4.38	2.18	5.46	2.24	7.77	2.46	13.98	2.47	2.85	1.32
Neuroticism	2.04	0.61	2.08	0.59	2.18	0.83	2.01	0.62	3.01	0.92	2.14	0.59
Extraversion	3.21	0.54	3.19	0.54	3.20	0.72	3.13	0.57	3.79	0.88	3.22	0.55
Openness	2.95	0.55	2.91	0.54	2.90	0.80	2.96	0.52	3.47	0.76	2.93	0.64
Agreeableness	3.54	0.47	3.51	0.47	3.60	0.49	3.43	0.51	4.80	0.71	3.46	0.51
Conscientiousness	3.37	0.47	3.34	0.47	3.30	0.67	3.41	0.45	4.74	0.71	3.38	0.54
Balance impairment (%)	33%	-	15%	-	37%	-	-	-	-	-	-	-
FTSST (seconds)	-	-	11.18	4.11	12.14	4.05	9.90	3.85	10.00	3.21	13.98	5.87

Note. HRS: *N* = 10837; ELSA: *N* = 5190; NHATS: *N* = 1857; MIDUS: *N* = 977; WLS: *N* = 6960; NSHAP: *N* = 1802.
[a]Percent of non-white participants.

NHATS is a longitudinal study of a nationally representative sample of Medicare enrollees aged 65 and older. One third of the sample provided information about personality, demographic factors, and balance/lower limb strength in 2013, and another third provided this information in 2014. A total of 2770 individuals had complete data on personality and demographic factors. Within this sample, 913 individuals were excluded because of missing data on balance/lower limb strength. The final analyzed sample had 1857 individuals (55% women; Mean Age = 77.96, SD = 6.92). NHATS data can be accessed at https://www.nhats.org/.

MIDUS is a longitudinal, nationally representative survey of non-institutionalized Americans. Complete data on personality and demographic factors were from 3814 individuals from MIDUS 2 (2004–2006). Of this sample, 2837 participants had missing data, resulting in 977 individuals (54% women; Mean Age = 55.06; SD = 11.60). MIDUS data can be accessed at https://midus.wisc.edu/index.php.

WLS is a longitudinal survey of Wisconsin high school graduates and their selected siblings. Data were available from the 2011 wave. A total of 7576 participants had complete data on personality and demographic factors. With 616 individuals with missing data on lower limb strength excluded, the final sample had 6960 individuals (53% women; Mean Age = 70.42; SD = 4.05). WLS data can be accessed at https://www.ssc.wisc.edu/wlsresearch/data/.

The NSHAP is a longitudinal population-based study of older Americans' health and social factors. Data were available from Wave 2 (2010–2011). Of an initial sample of 2062 participants with complete data on personality traits and demographic factors, 260 individuals with missing data on lower limb strength were excluded. The final analyzed sample had 1802 participants (52% women; Mean Age = 71.79; SD = 6.77). NSHAP data can be accessed at https://www.ssc.wisc.edu/wlsresearch/data/.

Measures

Personality. The five personality traits were measured using the Midlife Development Inventory (MIDI) (Zimprich et al., 2012) in the HRS (26-item version), ELSA (26-item version), MIDUS (25-item version), NHATS (10-item version), and NSHAP (21-item version). Respondents were asked to rate themselves on a list of adjectives on a four-point scale, ranging from 1 (*not at all*) to 4 (*a lot*). Example adjectives are worrying (neuroticism), active (extraversion), creative (openness), softhearted (agreeableness), and organized (conscientiousness). The WLS used the Big Five Inventory to assess personality (John et al., 1991). Respondents read 29 descriptive statements such as: "To what extent do you agree that you see yourself as someone who worries a lot?" (neuroticism), "To what extent do you agree that you see yourself as someone who generates a lot of enthusiasm?" (extraversion), "To what extent do you agree that you see yourself as someone who has an active imagination?" (openness), "To what extent do you agree that you see yourself as someone who is considerate to almost everyone?" (agreeableness), and "to what extent do you agree that you see yourself as someone who does things efficiently?" (conscientiousness). Participants rated each statement on a scale ranging from 1 (*disagree strongly*) to 6 (*agree strongly*). Within each sample, the mean of items was taken in the direction of higher neuroticism, extraversion, openness, agreeableness, and conscientiousness and z-scored for each trait.

Balance. In the HRS, standing balance was assessed in three separate stances. The semi-tandem balance task was conducted first. Respondents were asked to stand up with the side of the heel of one foot touching the toe of the other foot for about 10 seconds. If participants were unable to complete the semi-tandem task for 10 seconds, they were asked to perform the side-by-side tandem task, with both feet together side-by-side for 10 seconds. Participants who were able to perform the semi-tandem task were asked to perform the full-tandem balance task. They were asked to stand with the heel of one foot in front of and touching the toes of the other foot for about 30s (for participants aged 65 years and older) or 60s (for participants younger than 65 years old). In ELSA and NHATS, participants were first asked to complete the side-by-side task, followed by the semi-tandem for 10s and then the full-tandem position. Participants unable to perform the side-by-side test and the semi-tandem test for the full 10 seconds were not administered the next test. In ELSA, participants younger than 70 years old were asked to complete a 30s full-tandem task and those aged 70 and older performed a 10s full-tandem task. In NHATS, participants were asked to complete a 10s full-tandem. Building upon past research (Chen & Janke, 2014; Gale et al., 2018), balance impairment was defined as not being able to complete the full-tandem stance (coded as 1) (based on the time requirements described above) versus able to complete the stance (coded as 0) in the three samples.

Lower limb strength. The five times sit-to-stand test (FTSST) was used in ELSA, NHATS, MIDUS, WLS, and NSHAP. Participants were asked to stand up from a chair to a full standing position five times with arms folded across the chest. The task ended if participants used their arms to rise, were too tired to continue, or were unable to complete the test in 1 minute. The time required to complete the five repetitions was recorded in seconds. Slower time indicated worse performance, whereas faster time required to complete the five repetitions indicated better performance.

Covariates

Sociodemographic factors were controlled in all samples. Age was in years, and sex was coded as 1 for female and 0 for male. Education was reported in years in HRS and WLS and reported on a scale from 1 (no grade school) to 12 (doctoral level degree) in MIDUS, from 1 (no qualification) to 7 (NVQ4/NVQ5/Degree or equivalent) in ELSA, from 1 (no schooling completed) to 9 (Master's, professional or doctoral degree) in NHATS, and from 1 (none) to 6 (law, MD, or PhD) in the NSHAP. Race was included as covariate and was coded as 0 = not African American/Black, and 1 = African American/Black in MIDUS, HRS, NSHAP, and NHATS, whereas it was coded as 1 for not white and 0 for white in ELSA. Ethnicity was included in the HRS, NHATS, and NSHAP (1 = Hispanic or Latinx and 0 = non-Hispanic/Latinx).

Additional analyses included biological, clinical, behavioral, and psychological factors as potential mediating factors. C-reactive protein (CRP), BMI, disease burden, physical activity, and depressive symptoms were included as potential mediators of the association between personality and both balance impairment and lower limb strength (see Figure 1). These variables were included as mediators because of their recognized link with both personality (Hakulinen et al., 2015; Luchetti et al., 2014; Stephan et al., 2024; Sutin et al., 2016; Vainik et al., 2019; Wright et al., 2023) and lower extremity function (Lucena Germano et al., 2023; Rundel et al., 2021; Stathi et al., 2022; Tuttle et al., 2020). Assays of blood samples were used to obtain CRP in HRS, ELSA, MIDUS, and NSHAP. A natural log transformation was performed because of the skewed distribution of the values. Staff-assessed height and weight were used to compute BMI (kg/m^2) in HRS, ELSA, MIDUS, WLS, and NSHAP; self-reported height and weight were used to compute BMI in NHATS. In the HRS and ELSA, participants were asked to indicate how often they participated in vigorous and moderate physical activity on a scale from 1 (hardly ever or never) to 4 (more than once a week). The mean of the two items was taken. Participants in the MIDUS reported the frequency of their winter and summer vigorous and moderate leisure physical activity using a scale from 1 (never) to 6 (several times a week or more). The average of the four items was computed. In the NHATS, the sum of two items asking whether participants ever go walking for exercise (yes/no) and whether they ever spent time on vigorous activities in the last month (yes/no) was taken. In the WLS, the sum of the number of hours per month participants reported doing vigorous or light physical activities, both alone and with others during the last year was used. Participants in the NSHAP indicated how often they participated in vigorous physical activity or exercise over the last twelve months on a scale from 0 (never) to 5 (5 or more times per week). The CES-D (Radloff, 1977; Wallace et al., 2000) was used to assess depressive symptoms in HRS and ELSA (8 items), WLS (20 items), and the NSHAP (11 items). Answers were summed in HRS and ELSA and averaged in WLS and NSHAP, with higher scores indicating more depressive symptoms. The MIDUS used the Composite International Diagnostic Interview Short Form (CIDI-SF) (Kessler et al., 1998). Participants indicated their experience of depressive symptoms that lasted for two weeks of the last 12 months using a yes/no format. Answers were summed, with higher values indicating more depressive symptoms. In the NHATS, the Patient Health Questionnaire-2 (PHQ-2) (Kroenke et al., 2003) was used. Participants used a scale from 1 (not at all) to 4 (nearly everyday) to indicate how often they had little interest or pleasure in doing things and how often they felt down, depressed, or hopeless over the last month. The average of the two items was taken, with higher scores indicating more depressive symptoms. The sum of diagnosed conditions was used as a measure of disease burden in the six samples.

Data Analyses

Logistic regression was used to test the association between personality and balance impairment in HRS, NHATS, and ELSA. Each trait was entered separately as a predictor of balance impairment, controlling for sociodemographic factors. Additional logistic regression analyses included biological (when available), clinical, behavioral, and psychological factors to test whether these factors accounted for the association between personality and balance impairment. Linear regression analyses examined the association between personality and lower limb strength in NHATS, ELSA, MIDUS, WLS, and NSHAP. In each sample, personality traits were entered as separate predictors of performance on the FTSST, controlling for sociodemographic covariates. Estimates (standardized coefficients from linear regression and odds ratio from logistic regression) from the different samples were combined in a random-effect meta-analyses using the Comprehensive Meta-Analysis (Borenstein et al., 2022) and JAMOVI 2.3.18 software. The random-effect meta-analysis is a common approach and reflects the expectation that effects could vary from study to study due to the differences across studies.

The mediational role of biological, clinical, behavioral, and psychological factors in the association between personality and lower limb strength was tested using bootstrap analysis with the PROCESS macro (Hayes, 2018). This analysis was based on 5000 resamples of the dataset, allowing the estimation of the indirect effects and 95% confidence intervals (CI) for the indirect effects. Indirect effects were considered significant when 0 was not contained in the CI's. C-reactive protein (CRP), physical activity, disease burden, depressive symptoms, and BMI were tested as simultaneous mediators between personality and lower limb strength.

Exploratory analyses tested whether age and sex moderated the association between personality and markers of lower extremity function with an interaction between each trait and either age or sex in each sample. The estimates were combined in a random-effect meta-analysis.

Results

Balance Impairment

The proportion of participants with balance impairment was 15% ($N = 799$) in ELSA, 37% ($N = 678$) in NHATS, and 33%

(N = 3534) in HRS. Consistent with predictions, the meta-analyses indicated that higher extraversion, openness, and conscientiousness were related to lower risk of balance impairment (Table 2). These associations were significant in the three samples for openness and conscientiousness and in two samples for extraversion. Unexpectedly, higher agreeableness was also related to a lower risk of balance impairment in the meta-analysis (Table 2). However, this association was significant only in HRS, not in NHATS and ELSA. The results suggested that one standard deviation lower in extraversion, openness, agreeableness, and conscientiousness were related to a 15%, 19%, 8%, and 22% increased risk of balance impairment, respectively. Higher neuroticism was significantly associated with a higher risk of balance impairment in HRS and ELSA, but not in NHATS or the meta-analysis (Table 2). Biological, clinical, behavioral, and psychological factors partially accounted for the association between personality and balance impairment (Table 3).

Moderation analyses indicated that the association between higher conscientiousness and lower risk of balance impairment was stronger among older individuals (Supplemental Table S1). This age interaction was significant in one out of the three samples. Age did not moderate the association of the other personality traits. Sex did not moderate the associations between personality and balance impairment (Supplemental Table S2).

In sum, the meta-analysis revealed that higher extraversion, openness, agreeableness, and conscientiousness were related to a lower risk of balance impairment. Higher neuroticism was related to a higher risk of balance impairment in two out of the three samples, but not in the meta-analysis.

Lower Limb Strength

The meta-analysis indicated that higher neuroticism was related to a longer time to complete the FTSST, indicating worse performance (Table 4). In contrast, higher extraversion, openness, and conscientiousness were associated with less time to complete the lower limb strength task, indicating better performance (Table 4). Unexpectedly, higher agreeableness was associated with better performance on the task (Table 4). The association with extraversion, openness, agreeableness, and conscientiousness was significant in four out of five samples; the association with neuroticism was significant in three samples.

Results from bootstrap mediation analyses are in Table 5. Neuroticism was associated with worse lower limb strength partly through higher depressive symptoms (proportion mediated: 48%–52%) and higher disease burden (17%–24% mediated) in three samples (Table 5). Furthermore, there was replicable evidence of a mediating role of lower depressive symptoms and higher physical activity in the association between higher extraversion (three samples for depressive symptoms, 10%–12% proportion mediated, and four samples for physical activity, 3%–11% mediated), openness (three samples for depressive symptoms, 8%–25% mediated, and four samples for physical activity, 6%–25% mediated), agreeableness (four samples for depressive symptoms, 9%–32% mediated and three samples for physical activity, 5%–12% mediated), and conscientiousness (four samples for depressive symptoms, 7%–18% mediated and physical activity, 5%–13%) and better performance on the lower limb task (Table 5). Additionally, lower disease burden partially mediated the association between higher extraversion (proportion mediated: 5%–8%) and conscientiousness (proportion mediated: 5%–13%) and better performance in three and four samples, respectively (Table 5). Less replicable evidence was found for the mediation by BMI and CRP. The association between extraversion and conscientiousness and lower limb strength remained significant in four samples, indicating that biological, clinical, behavioral, and psychological factors partially mediated these associations.

A meta-analysis revealed a significant interaction between age and extraversion, openness, and conscientiousness on lower limb strength (supplemental Table S3). Although the association between extraversion, openness, conscientiousness, and lower limb strength was observed across age, it was stronger among older individuals. However, there was some heterogeneity across the samples. Indeed, age significantly interacted with extraversion in three samples, openness in two samples, and conscientiousness in one sample. There was no overall interaction between agreeableness and age. There

Table 2. Summary of Logistic Regression Analysis Predicting Risk of Balance Impairment From Personality Traits.

	Neuroticism OR 95%CI	Extraversion OR 95%CI	Openness OR 95%CI	Agreeableness OR 95%CI	Conscientiousness OR 95%CI
HRS[a]	1.24*** (1.19–1.30)	0.80*** (0.77–0.84)	0.83*** (0.80–0.87)	0.90*** (0.87–0.95)	0.81*** (0.77–0.84)
ELSA[b]	1.13** (1.05–1.23)	0.80*** (0.74–0.87)	0.84*** (0.78–0.91)	0.96 (0.88–1.03)	0.85*** (0.79–0.92)
NHATS[a]	0.93 (0.83–1.03)	1.03 (0.93–1.14)	0.87** (0.78–0.96)	0.96 (0.87–1.07)	0.82*** (0.74;0.91)
Random effect	1.10 (0.94–1.29)	0.87* (0.79–0.99)	0.84*** (0.81–0.87)	0.93*** (0.89–0.96)	0.82*** (0.79–0.85)
I^2	92.79	90.03	0	0	0

Note. HRS: N = 10837; ELSA: N = 5190; NHATS: N = 1857; $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.
[a]Adjusted for age, sex, education, race, and ethnicity.
[b]Adjusted for age, sex, education, and race.

Table 3. Summary of Logistic Regression Analysis Predicting Risk of Balance Impairment From Personality Traits Controlling for Biological, Clinical, Behavioral, and Psychological Factors.

	Neuroticism OR 95%CI	Extraversion OR 95%CI	Openness OR 95%CI	Agreeableness OR 95%CI	Conscientiousness OR 95%CI
HRS[a]	1.13*** (1.07–1.19)	0.88*** (0.83–0.92)	0.88*** (0.83–0.92)	0.92** (0.87–0.97)	0.89*** (0.85–0.94)
ELSA[a]	1.01 (0.91–1.12)	0.89* (0.80–0.97)	0.85*** (0.77–0.93)	0.96 (0.87–1.05)	0.93 (0.85–1.02)
NHATS[b]	0.91 (0.81–1.01)	1.04 (0.94–1.16)	0.88* (0.79–0.98)	0.96 (0.86–1.07)	0.84*** (0.75–0.93)

Note. *p < .05, **p < .01, ***p < .001, HRS: N = 8767; ELSA: N = 4031; NHATS: N = 1828;
[a]Adjusted for demographic factors, CRP, BMI, disease burden, physical activity, and depressive symptoms,
[b]Adjusted for demographic factors, BMI, disease burden, physical activity, and depressive symptoms.

Table 4. Summary of Regression Analysis Predicting Lower Limb Strength From Personality Traits.

	Neuroticism β	Extraversion β	Openness β	Agreeableness β	Conscientiousness β
ELSA[a]	0.07*** (0.04; 0.09)	−0.16*** (−0.18; −0.13)	−0.07*** (−0.10; −0.04)	−0.04** (−0.06; −0.10)	−0.09*** (−0.12; −0.07)
NHATS[b]	0.03 (−0.02; 0.07)	−0.09*** (−0.13; −0.04)	−0.05* (−0.09; 0.007)	−0.06** (−0.10; −0.02)	−0.11*** (−0.15; −0.07)
MIDUS[a]	0.04 (−0.02; 0.10)	−0.03 (−0.09; 0.03)	0.02 (−0.04; 0.08)	−0.00 (−0.07; 0.06)	−0.04 (−0.10; 0.02)
WLS[c]	0.07*** (0.04; 0.09)	−0.12*** (−0.14; −0.10)	−0.04** (−0.06; −0.01)	−0.07*** (−0.09; −0.04)	−0.12*** (−0.14; −0.10)
NSHAP[b]	0.05* (0.004; 0.10)	−0.14*** (−0.18; −0.09)	−0.08*** (−0.13; −0.04)	−0.06* (−0.10; −0.008)	−0.15*** (−0.19; −0.10)
Random effect	0.06*** (0.047; 0.077)	−0.11*** (−0.154; −0.073)	−0.05*** (−0.074; −0.025)	−0.05*** (−0.072; −0.035)	−0.11*** (−0.135; −0.078)
I^2	0	83.34	54.16	24.29	64.9

Note. ELSA: N = 5190; NHATS: N = 1857; MIDUS: N = 977; WLS: N = 6960; NSHAP: N = 1802; *p < .05, **p < .01, ***p < .001.
β = Standardized regression coefficient;
[a]Adjusted for age, sex, education, and race;
[b]Adjusted for age, sex, education, race, and ethnicity;
[c]Adjusted for age, sex, and education.

were fewer significant interactions between personality and sex. The meta-analysis indicated a stronger association between conscientiousness and better performance among females, which was significant in two of the five samples (Supplemental Table S4).

In sum, higher neuroticism was related to weaker lower limb strength, whereas higher extraversion, openness, agreeableness, and conscientiousness were associated with better lower limb strength. The link between neuroticism and lower limb strength was mostly mediated by higher depressive symptoms and higher disease burden. In contrast, lower depressive symptoms, lower disease burden, and higher physical activity were the most consistent mediators of the association between extraversion and conscientiousness and lower limb strength. The link between openness and agreeableness and lower limb strength was mostly mediated by lower depressive symptoms and higher physical activity.

Discussion

Based on six large samples of middle-aged and older adults, the present study examined whether the five major dimensions of personality were associated with balance (assessed with tandem stances) and lower limb strength (assessed with sit-to-stand test). The meta-analysis indicated that neuroticism was related to weaker legs (expected) but unrelated to balance (unexpected). As predicted, higher extraversion, openness, and conscientiousness were associated with a lower risk of balance impairment and stronger legs. Unexpectedly, the meta-analysis indicated that agreeableness was related to a decreased risk of balance impairment and better lower limb strength. These associations were replicated across samples from different countries, with different demographic characteristics, and using different personality measures (including different versions of the same instrument in HRS, MIDUS, NSHAP, ELSA, and NHATS). Furthermore, the present study found that the link between personality and balance impairment and lower limb strength was partly explained by biological, clinical, behavioral, and psychological factors. There was some evidence of a stronger association between personality and lower extremity function with increasing age, but the difference was modest. Taken as a whole, this study addresses a gap in the literature on the association between personality and physical functioning by

Table 5. Summary of Bootstrap Analysis.

Variables	Bootstrap Analysis[a]				
	Neuroticism	Extraversion	Openness	Agreeableness	Conscientiousness
ELSA					
Depressive symptoms	.14 (.088; .198)	−.08 (−.116; −.047)	−.05 (−.082; −.034)	−.028 (−.045; −.013)	−.064 (−.091; −.039)
BMI	−.003 (−.011; .005)	−.007 (−.017; −.0005)	.003 (−.004; .012)	.005 (−.001; .014)	−.01 (−.027; −.005)
Physical activity	.03 (.010;.046)	−.07 (−.099; −.052)	−.043 (−.063; −.024)	.003 (−.014; .022)	−.05 (−.068; −.027)
Disease burden	.07 (.044;.095)	−.05 (−.079; −.033)	−.024 (−.043; −.008)	−.003 (−.018; .013)	−.05 (−.079; −.033)
CRP	−.001 (−.007; .004)	−.001 (−.007; .004)	.001 (−.003; .008)	.003 (−.002; .010)	−.006 (−.014; −.0007)
Direct effect[b]	.02	−.10***	−.03*	−.03	−.03*
NHATS					
Depressive symptoms	.10 (.039; .166)	−.04 (−.069; −.012)	−.01 (−.032; .006)	−.04 (−.075; −.015)	−.04 (−.076; −.013)
BMI	−.007 (−.023; .004)	.02 (.004; .043)	.003 (−.008; .016)	.009 (−.002; .002)	−.01 (−.027; .0004)
Physical activity	.004 (−.021; .030)	−.04 (−.074; −.019)	−.05 (−.082; −.021)	−.03 (−.055; −.003)	−.04 (−.064; −.012)
Disease burden	.04 (.016; .072)	−.02 (−.052; −.001)	−.01 (−.039; .010)	−.002 (−.031; .024)	−.04 (−.072; −.015)
CRP	-	-	-	-	-
Direct effect[b]	.00	−.07***	−.03	−.05*	−.08***
MIDUS					
Depressive symptoms	.09 (.014; .178)	−.03 (−.067; −.002)	−.006 (−.033; .017)	−.01 (−.042; .011)	−.03 (−.078; −.003)
BMI	−.002 (−.021; .015)	−.02 (−.047; .003)	−.009 (−.033; .006)	.01 (−.005; .034)	−.009 (−.034; .005)
Physical activity	.01 (−.014; .053)	−.06 (−.104; −.020)	−.04 (−.084; −.008)	.001 (−.030.; 030)	−.01 (−.051.; 014)
Disease burden	.06 (−.003; .127)	−.02 (−.050; .002)	−.001 (−.020.; 018)	−.007 (−.030.; 010)	−.02 (−.062.; 002)
CRP	−.002 (−.036; .032)	.01 (−.016; .048)	−.006 (−.040.; 023)	.03 (.001.; 072)	−.03 (−.064.; 004)
Direct effect[b]	−.01	−.01	.03	−.01	−.01
WLS					
Depressive symptoms	.11 (.076; .150)	−.04 (−.060; −.028)	−.03 (−.039; −.016)	−.07 (−.095; −.049)	−.07 (−.095; −.045)
BMI	−.02 (−.032; −.0008)	.002 (−.012; .017)	−.000 (−.017; .016)	−.04 (−.054; −.021)	−.07 (−.090; −.054)
Physical activity	.002 (−.004; .008)	−.01 (−.022; −.007)	−.007 (−.015; −.0003)	−.01 (−.020; −.005)	−.02 (−.028; −.009)
Disease burden	.05 (.034; .064)	−.02 (−.037; −.015)	.03 (.014; .039)	−.02 (−.033; −.010)	−.04 (−.059; −.029)
CRP	-	-	-	-	-
Direct effect[b]	.00	−.09***	−.02	−.01	−.05***
NSHAP					
Depressive symptoms	.15 (.048; .250)	−.06 (−.124; .0002)	−.04 (−.084; −.009)	−.03 (−.068; −.005)	−.06 (−.122; −.002)
BMI	−.001 (−.029; .009)	−.000 (−.033; .008)	−.000 (−.027; .013)	.002 (−.026; .014)	.001 (−.062; .005)
Physical activity	.02 (−.006; .057)	−.09 (−.154; −.019)	.09 (−.145; −.025)	−.04 (−.078; −.006)	−.08 (−.134; −.020)
Disease burden	.05 (.014; .010)	−.02 (−.053; .001)	−.02 (−.045; .007)	−.000 (−.026; .023)	−.04 (−.075; −.006)
CRP	.001 (−.007; .010)	−.005 (−.020; .014)	−.002 (−.013; .008)	−.001 (−.010; .008)	−.005 (−.027; .022)
Direct effect[b]	−.00	−.12***	−.06*	−.03*	−.12***

Note. ELSA: N = 4031; MIDUS: N = 968; NHATS: N = 1828; WLS: N = 6062; NSHAP: N = 1639; $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$;
[a]Bootstrap estimates and 95% bias-corrected confidence interval for indirect effects of personality traits on FTSST performance through mediators controlling for demographic factors;
[b]Direct effect of personality traits on FTSST performance adjusted for mediators and demographic factors.

providing novel evidence based on coordinated analyses in multiple cohorts.

To the best of our knowledge, this study is the first to identify a link between personality and both balance and lower limb strength. Therefore, these findings extend past research on personality and gait speed (Kekalainen et al., 2020; Stephan et al., 2018; Terracciano et al., 2013) to other crucial markers of lower extremity function. In contrast to the null results reported for walking speed (Stephan et al., 2018), agreeableness was found to relate to better lower extremity function in the present study. In addition, this study is broadly consistent with existing evidence on personality (high neuroticism and low extraversion, openness, agreeableness, and conscientiousness) and frailty, which is characterized by lower physical function, mobility limitations, and loss of muscle mass (Gale et al., 2017; Stephan et al., 2017). In addition, the link between higher neuroticism and lower conscientiousness and higher balance impairment and weaker lower limb strength supports evidence for the association between these traits and falls (Canada et al., 2020). Finally, the overall pattern of association between personality traits and lower limb strength was mostly consistent with findings of a recent study using a dynamometer-based measure of upper body muscle strength (Stephan et al., 2022b). Therefore, the association between personality and muscle strength generalizes across different measures.

There was heterogeneity in the association between neuroticism and balance impairment. In particular, neuroticism was not related to balance impairment in the meta-analysis, which was mainly driven by the non-significant association in the NHATS. In contrast, higher neuroticism was significantly related to an increased risk of balance impairment in both the HRS and ELSA. There are two main differences between NHATS and both HRS and ELSA. First, NHATS is an older sample. Second, there were differences in the content of the neuroticism scale. HRS and ELSA used the full MIDI, whereas the NHATS assessed neuroticism with two items on nervousness and worry. It may be the emotional instability component of neuroticism, rather than its anxiety component, that is important for balance.

Emotionally stable (low neuroticism), extraverted, open, agreeable, and conscientious individuals have biological, psychological, health-related, and behavioral profiles that may help strengthen and maintain lower extremity functions. For example, low neuroticism and high extraversion, openness, agreeableness, and conscientiousness have been associated with more frequent physical activity (Sutin et al., 2016), fewer depressive symptoms (Hakulinen et al., 2015), and decreased risk of chronic conditions (Weston et al., 2015). In addition, extraversion, openness, and conscientiousness have been associated with lower inflammation (Luchetti et al., 2014; Stephan et al., 2024). Consistent with this hypothetical model, the present study found that the relation between extraversion, openness, agreeableness, and conscientiousness and reduced risk of balance impairment was partially accounted for by biological, clinical, behavioral, and psychological factors. In addition, fewer depressive symptoms and lower physical activity, and to a lesser extent lower disease burden, partially mediated the link between these traits and better lower limb strength. Also consistent with existing research on the link between personality and grip strength (Stephan et al., 2022a), higher neuroticism was associated with weaker lower limb strength in part through its association with higher depressive symptoms and higher disease burden. There was little replication of a mediating role of either CRP or BMI across the analyses, which is also broadly in line with past research (Stephan et al., 2022b). Across the five traits, depressive symptoms were the most important mediators (with the highest proportion of effect mediated) of the association between personality and lower limb strength. Although they were also consistent mediators, the proportion mediated by disease burden and physical activity was lower but comparable. Taken as a whole, this mediational pattern indicates that the association between personality and different measures of strength, such as lower limb strength and grip strength operate through similar mechanisms. Furthermore, consistent with existing theoretical models (see Chapman et al., 2014; Grogan et al., 2023), these associations were mediated by different categories of factors, including affective, behavioral, and clinical factors.

Depressive symptoms, disease burden, and physical activity did not fully mediate the association between personality traits and lower limb strength, which suggests that other pathways may operate. For example, higher neuroticism and lower conscientiousness have been associated with lower mitochondrial DNA copy number (Oppong et al., 2022), which is related to higher risk of sarcopenia (McCastlain et al., 2021). Furthermore, higher neuroticism and lower extraversion and conscientiousness have been related to immunosenescence (Stephan et al., 2023c), which is implicated in decline in muscle health (Pellegrino et al., 2024). Sensory function may also explain part of the association between personality and balance. Indeed, higher neuroticism and lower openness and conscientiousness have been associated with increased risk of hearing impairment (Stephan et al., 2019), which contributes to lower performance on the FTSST and worse overall lower extremity function (Foster et al., 2022). In addition, recent research found that higher conscientiousness is related to a decreased risk of vision impairment (Stephan et al., 2023a), which is implicated in better standing balance and lower limb strength (Thompson et al., 2023). Finally, personality may be related to balance and lower limb strength through psychological factors. For example, higher neuroticism and lower extraversion, openness, agreeableness, and conscientiousness are associated with higher fatigue (Stephan et al., 2022b), which may manifest in more serious difficulties in maintaining balance and strength.

The association between personality and markers of lower extremity function could inform about potential pathways linking personality to a range of health-related outcomes among older adults. For example, higher neuroticism and lower conscientiousness might increase the risk of falls (Canada et al., 2020) and hospitalization (Willroth et al., 2023) partly through poor balance and weak legs. Impaired lower extremity functions may also link higher neuroticism and lower extraversion, openness, agreeableness, and conscientiousness to more difficulties with instrumental activities of daily living (IADLs) (Canada et al., 2021).

The strengths of the present study are (a) the six large population-based samples, (b) the assessment of all five major domains of personality, (c) the objective measures of balance and lower limb strength, (d) the coordinated analyses across samples and meta-analytic synthesis, and (e) the testing of potential biological, behavioral, psychological, and clinical mediators and moderators. Several limitations also need to be considered. Causal inference is limited by the observational design. Personality was modeled as a predictor of lower extremity function, but both balance and lower limb strength may also predict personality. Additional research using a longitudinal design is needed to examine these reciprocal relationships. Although various mediators were examined, more research is needed to test additional pathways through which personality is associated with lower extremity function. Future research may examine the personality facets related to lower extremity function to obtain a more in-depth assessment of which aspect of personality is most strongly related to these crucial physical functions. Finally, the present study included samples from the US and the UK. Future research should test whether these associations replicate in samples from middle and low-income nations and other world regions.

In sum, the present study indicates that higher neuroticism is associated with an increased risk of balance impairment and weaker lower limb strength, whereas higher extraversion, openness, agreeableness, and conscientiousness are associated with lower risk of balance impairment and better lower limb strength.

Acknowledgments

The Health and Retirement Study (HRS) is sponsored by the National Institute on Aging (NIA-U01AG009740) and conducted by the University of Michigan. The Midlife in the United States (MIDUS) is sponsored by the MacArthur Foundation Research Network on Successful Midlife Development, the National Institute on Aging (P01-AG020166; U19-AG051426), and grants from the General Clinical Research Centers Program (M01-RR023942, M01-RR00865) and the National Center for Advancing Translational Sciences (UL1TR000427). Funding for the English Longitudinal Study of Ageing is provided by the National Institute of Aging [grants 2RO1AG7644-01A1 and 2RO1AG017644] and a consortium of UK government departments coordinated by the Office for National Statistics. The National Health and Aging Trends Study (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. The Wisconsin Longitudinal Study (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. The National Social Life, Health and Aging Project (NSHAP) is supported by the National Institutes of Health, including the National Institute on Aging, the Office of Women's Health Research, the Office of AIDS Research, and the Office of Behavioral and Social Sciences Research (grants R01 AG021487, R37 AG030481, R01 AG033903, R01 AG043538, and R01 AG048511).

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by the National Institute on Aging of the National Institutes of Health (grant numbers R01AG068093, R01AG053297). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Ethical Statement

Ethical Approval

The HRS was approved by the University of Michigan Institutional Review Board (IRB). The MIDUS Study was approved by the Education and Social/Behavioral Sciences and the Health Sciences IRB at the University of Wisconsin-Madison. The National Research Ethics Service approved ELSA. The NHATS was approved by the Johns Hopkins Bloomberg School of Public Health IRB. The WLS received approval from the Health Sciences IRB at University of Wisconsin–Madison. The NSHAP was approved by the Social and Behavioral Sciences IRB at the University of Chicago and the NORC IRB. Written informed consent was obtained from all participants in each sample. The present study was exempt from IRB approval because it used de-identified publicly available data.

ORCID iDs

Yannick Stephan https://orcid.org/0000-0002-8029-8809
Angelina R. Sutin https://orcid.org/0000-0002-1824-8974
Andre Hajek https://orcid.org/0000-0002-6886-2745
Tiia Kekalainen https://orcid.org/0000-0003-0160-727X

Data Availability Statement

HRS data are publicly available at https://hrsonline.isr.umich.edu/. MIDUS data can be accessed at https://midus.wisc.edu/index.php. ELSA data are available from the UK Data Service (UKDS, https://www.ukdataservice.ac.uk/). NHATS data are available for public download at: https://www.nhats.org/. WLS data are available at https://researchers.wls.wisc.edu/. Information on how to access the NSHAP data can be found at: https://www.norc.org/Research/Projects/Pages/national-social-life-health-and-aging-project.aspx.

Supplemental Material

Supplemental material for this article is available online.

References

Borenstein, M., Hedges, L., Higgins, J., & Rothstein, H. (2022). *Comprehensive Meta-Analysis Version 2*. Biostat.

Bos, E. G. T., Douairi, J., Kok, R. M., Koolhoven, I., Rius Ottenheim, N., Rhebergen, D., & Oude Voshaar, R. C. (2023). *The Impact of Personality Traits on the Course of Frailty.* Clinical Gerontologist. https://doi.org/10.1080/07317115.2023.2165469

Canada, B., Stephan, Y., Fundenberger, H., Sutin, A. R., & Terracciano, A. (2021). Cross-sectional and prospective association between personality traits and IADL/ADL limitations. *Psychology and Aging*, *36*(3), 309–321. https://doi.org/10.1037/pag0000502

Canada, B., Stephan, Y., Sutin, A. R., & Terracciano, A. (2020). Personality and falls among older adults: Evidence from a longitudinal cohort. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *75*(9), 1905–1910. https://doi.org/10.1093/geronb/gbz040

Chapman, B. P., Hampson, S., & Clarkin, J. (2014). Personality-informed interventions for healthy aging: Conclusions from a national Institute on aging work group. *Developmental Psychology*, *50*(5), 1426–1441. https://doi.org/10.1037/a0034135

Chen, T. Y., & Janke, M. C. (2014). Predictors of falls among community-dwelling older adults with cancer: Results from the health and retirement study. *Supportive Care in Cancer*, *22*(2), 479–485. https://doi.org/10.1007/s00520-013-2000-7

Costa, P. T. Jr., McCrae, R. R., & Löckenhoff, C. E. (2019). Personality across the life span. *Annual Review of Psychology*, *70*, 423–448. https://doi.org/10.1146/annurev-psych-010418-103244

Foster, J. I., Williams, K. L., Timmer, B. H. B., & Brauer, S. G. (2022). The association between hearing impairment and postural stability in older adults: A systematic review and meta-analysis. *Trends in Hearing*, *26*, Article 23312165221144155. https://doi.org/10.1177/23312165221144155

Gale, C. R., Mõttus, R., Deary, I. J., Cooper, C., & Sayer, A. A. (2017). Personality and risk of frailty: The English longitudinal study of ageing. *Annals of Behavioral Medicine*, *51*(1), 128–136. https://doi.org/10.1007/s12160-016-9833-5

Gale, C. R., Westbury, L. D., Cooper, C., & Dennison, E. M. (2018). Risk factors for incident falls in older men and women: The English longitudinal study of ageing. *BMC Geriatrics*, *18*(1), 117. https://doi.org/10.1186/s12877-018-0806-3

Germano, M. L., Dos Santos Gomes, C., de Souza Barbosa, J. F., Neto, N. J., Pereira, D. S., Ahmed, T., Borrero, C. L. C., & Guerra, R. O. (2023). Allostatic load and physical performance in older adults: Findings from the international mobility in aging study (IMIAS). *Archives of Gerontology and Geriatrics*, *109*, Article 104961. https://doi.org/10.1016/j.archger.2023.104961

Grogan, C. S., Turiano, N. A., Habenicht, A., McGeehan, M., & O'Súilleabháin, P. S. (2024). Personality traits and mediating pathways to mortality risk: A systematic review. *Health Psychology*, *43*(3), 214–224. https://doi.org/10.1037/hea0001335

Hajek, A., & König, H.-H. (2021). Personality and functional impairment. Evidence from the survey of health, ageing and retirement in europe. *Psychogeriatrics*, *21*(6), 861–868. https://doi.org/10.1111/psyg.12751

Hajek, A., Kretzler, B., & König, H. H. (2021). Relationship between personality factors and frailty. A systematic review. *Archives of Gerontology and Geriatrics*, *97*, Article 104508. https://doi.org/10.1016/j.archger.2021.104508

Hakulinen, C., Elovainio, M., Pulkki-Råback, L., Virtanen, M., Kivimäki, M., & Jokela, M. (2015). Personality and depressive symptoms: Individual participant meta-analysis of 10 cohort studies. *Depression and Anxiety*, *32*(7), 461–470. https://doi.org/10.1002/da.22376

Hayes, A. F. (2018). *Introduction to mediation, moderation, and conditional process analysis* (2nd ed.): The Guilford Press.

John, O. P., Donahue, E. M., & Kentle, R. L. (1991). *The Big Five Inventory–Versions 4a and 54*. Berkeley, CA: University of California,Berkeley, Institute of Personality and Social Research.

Kekäläinen, T., Terracciano, A., Sipilä, S., & Kokko, K. (2020). Personality traits and physical functioning: A cross-sectional multimethod facet-level analysis. *European Review of Aging and Physical Activity*, *17*(1), 20. https://doi.org/10.1186/s11556-020-00251-9

Kessler, R. C., Andrews, G., Mroczek, D., Ustun, B., & Wittchen, H.-U. (1998). The world health organization composite international diagnostic Interview Short Form (CIDI-SF). *International Journal of Methods in Psychiatric Research*, *7*(4), 171–185. https://doi.org/10.1002/mpr.47

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2003). The patient health questionnaire-2: Validity of a two-item depression screener. *Medical Care*, *41*(11), 1284–1292. https://doi.org/10.1097/01.MLR.0000093487.78664.3C

Luchetti, M., Barkley, J. M., Stephan, Y., Terracciano, A., & Sutin, A. R. (2014). Five-factor model personality traits and inflammatory markers: New data and a meta-analysis. *Psychoneuroendocrinology*, *50*, 181–193. https://doi.org/10.1016/j.psyneuen.2014.08.014

Luo, J., Zhang, B., Graham, E. K., & Mroczek, D. K. (2023). Does personality always matter for health? Examining the moderating effect of age on the personality-health link from life span developmental and aging perspectives. *Journal of Personality and Social Psychology*, *125*(5), 1189–1206. https://doi.org/10.1037/pspp0000485

McCastlain, K., Howell, C. R., Welsh, C. E., Wang, Z., Wilson, C. L., Mulder, H. L., Easton, J., Mertens, A. C., Zhang, J., Yasui, Y., Hudson, M. M., Robison, L. L., Kundu, M., & Ness, K. K. (2021). The association of mitochondrial copy number with sarcopenia in adult survivors of childhood cancer. *Journal of the National Cancer Institute*, *113*(11), 1570–1580. https://doi.org/10.1093/jnci/djab084

McCrae, R. R., & John, O. P. (1992). An introduction to the five-factor model and its applications. *Journal of Personality*, *60*(2), 175–215. https://doi.org/10.1111/j.1467-6494.1992.tb00970.x

Mueller, S., Wagner, J., Smith, J., Voelkle, M. C., & Gerstorf, D. (2018). The interplay of personality and functional health in old and very old age: Dynamic within-person interrelations across up to 13 years. *Journal of Personality and Social Psychology*, *115*(6), 1127–1147. https://doi.org/10.1037/pspp0000173

Oppong, R. F., Terracciano, A., Picard, M., Qian, Y., Butler, T. J., Tanaka, T., Moore, A. Z., Simonsick, E. M., Opsahl-Ong, K., Coletta, C., Sutin, A. R., Gorospe, M., Resnick, S. M., Cucca, F., Scholz, S. W., Traynor, B. J., Schlessinger, D., Ferrucci, L., & Ding, J. (2022). Personality traits are consistently associated with blood mitochondrial DNA copy number estimated from genome sequences in two genetic cohort studies. *Elife*, *11*, Article e77806. https://doi.org/10.7554/eLife.77806

Pavasini, R., Guralnik, J., Brown, J. C., di Bari, M., Cesari, M., Landi, F., Vaes, B., Legrand, D., Verghese, J., Wang, C., Stenholm, S., Ferrucci, L., Lai, J. C., Bartes, A. A., Espaulella, J., Ferrer, M., Lim, J. Y., Ensrud, K. E., Cawthon, P., & Campo, G. (2016). Short physical performance battery and all-cause mortality: Systematic review and meta-analysis. *BMC Medicine*, *14*(1), 215. https://doi.org/10.1186/s12916-016-0763-7

Pellegrino, R., Paganelli, R., Di Iorio, A., Bandinelli, S., Moretti, A., Iolascon, G., Sparvieri, E., Tarantino, D., Tanaka, T., & Ferrucci, L. (2024). Beyond inflammaging: The impact of immune system aging on age-related muscle decline, results from the InCHIANTI study. *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences*, *79*(2), glad238. https://doi.org/10.1093/gerona/glad238

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, *1*(3), 385–401. https://doi.org/10.1177/014662167700100306

Rantakokko, M., Mänty, M., & Rantanen, T. (2013). Mobility decline in old age. *Exercise and Sport Sciences Reviews*, *41*(1), 19–25. https://doi.org/10.1097/JES.0b013e3182556f1e

Rundell, S. D., Karmarkar, A., Nash, M., & Patel, K. V. (2021). Associations of multiple chronic conditions with physical performance and falls among older adults with back pain: A longitudinal, population-based study. *Archives of Physical Medicine and Rehabilitation*, *102*(9), 1708–1716. https://doi.org/10.1016/j.apmr.2021.03.025

Stathi, A., Greaves, C. J., Thompson, J. L., Withall, J., Ladlow, P., Taylor, G., Medina-Lara, A., Snowsill, T., Gray, S., Green, C., Johansen-Berg, H., Sexton, C. E., Bilzon, J. L. J., deKoning, J., Bollen, J. C., Moorlock, S. J., Western, M. J., Demnitz, N., Seager, P., & Fox, K. R. (2022). Effect of a physical activity and behaviour maintenance programme on functional mobility decline in older adults: The REACT (Retirement in Action) randomised controlled trial. *The Lancet Public Health*, *7*(4), e316–e326. https://doi.org/10.1016/S2468-2667(22)00004-4

Stephan, Y., Sutin, A. R., Bovier-Lapierre, G., & Terracciano, A. (2018). Personality and walking speed across adulthood: Prospective evidence from five samples. *Social Psychological and Personality Science*, *9*(7), 773–780. https://doi.org/10.1177/1948550617725152

Stephan, Y., Sutin, A. R., Caille, P., & Terracciano, A. (2019). Personality and hearing acuity: Evidence from the health and retirement study and the English longitudinal study of ageing. *Psychosomatic Medicine*, *81*(9), 808–813. https://doi.org/10.1097/PSY.0000000000000734

Stephan, Y., Sutin, A. R., Canada, B., Deshayes, M., Kekäläinen, T., & Terracciano, A. (2022a). Five-factor model personality traits and grip strength: Meta-analysis of seven studies. *Journal of Psychosomatic Research*, *160*, Article 110961. https://doi.org/10.1016/j.jpsychores.2022.110961

Stephan, Y., Sutin, A. R., Canada, B., & Terracciano, A. (2017). Personality and frailty: Evidence from four samples. *Journal of Research in Personality*, *66*, 46–53. https://doi.org/10.1016/j.jrp.2016.12.006

Stephan, Y., Sutin, A. R., Luchetti, M., Canada, B., & Terracciano, A. (2022b). Personality and fatigue: meta-analysis of seven prospective studies. *Scientific Reports*, *12*(1), 9156. https://doi.org/10.1038/s41598-022-12707-2

Stephan, Y., Sutin, A. R., Luchetti, M., Aschwanden, D., Caille, P., & Terracciano, A. (2023a). Personality associations with lung function and dyspnea: Evidence from six studies. *Respiratory Medicine*, *208*, Article 107127. https://doi.org/10.1016/j.rmed.2023.107127

Stephan, Y., Sutin, A. R., Luchetti, M., Aschwanden, D., & Terracciano, A. (2023b). Personality and aging-related immune phenotype. *Psychoneuroendocrinology*, *153*, Article 106113. https://doi.org/10.1016/j.psyneuen.2023.106113

Stephan, Y., Sutin, A. R., & Terracciano, A. (2023c). Personality traits and the risk of sensory impairment: Evidence from the national health and aging Trends study. *Journal of Psychosomatic Research*, *173*, Article 111459. https://doi.org/10.1016/j.jpsychores.2023.111459

Stephan, Y., Sutin, A. R., Luchetti, M., Aschwanden, D., & Terracciano, A. (2024). Personality and cognition: The mediating role of inflammatory markers. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *79*(1), gbad152. https://doi.org/10.1093/geronb/gbad152

Strickhouser, J. E., Zell, E., & Krizan, Z. (2017). Does personality predict health and well-being? A metasynthesis. *Health Psychology*, *36*(8), 797–810. https://doi.org/10.1037/hea0000475

Sutin, A. R., Stephan, Y., Luchetti, M., Artese, A., Oshio, A., & Terracciano, A. (2016). The five-factor model of personality and physical inactivity: A meta-analysis of 16 samples. *Journal of Research in Personality*, *63*, 22–28. https://doi.org/10.1016/j.jrp.2016.05.001

Terracciano, A., Schrack, J. A., Sutin, A. R., Chan, W., Simonsick, E. M., & Ferrucci, L. (2013). Personality, metabolic rate and aerobic capacity. *PLoS One*, *8*(1), Article e54746. https://doi.org/10.1371/journal.pone.0054746

Terracciano, A., Stephan, Y., Luchetti, M., Gonzalez-Rothi, R., & Sutin, A. R. (2017). Personality and lung function in older adults. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *72*(6), 913–921. https://doi.org/10.1093/geronb/gbv161

Thompson, A. C., Johnson, E., Miller, M. E., Williamson, J. D., Newman, A. B., Cummings, S., Cawthon, P., & Kritchevsky, S. B. (2023). The relationship between visual function and physical performance in the Study of Muscle, Mobility and Aging (SOMMA). *PLoS One*, *18*(9), Article e0292079. https://doi.org/10.1371/journal.pone.0292079

Tolea, M. I., Costa, P. T. Jr., Terracciano, A., Ferrucci, L., Faulkner, K., Coday, M. M., Ayonayon, H. N., & Simonsick, E. M.Health Aging and Body Composition Study. (2012). Associations of openness and conscientiousness with walking speed decline: Findings from the health, aging, and body composition study. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *67*(6), 705–711. https://doi.org/10.1093/geronb/gbs030

Tolea, M. I., Costa, P. T., Terracciano, A., Griswold, M., Simonsick, E. M., Najjar, S. S., Scuteri, A., Deiana, B., Orrù, M., Masala, M., Uda, M., Schlessinger, D., & Ferrucci, L. (2010). Sex-specific correlates of walking speed in a wide age-ranged population. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *65B*(2), 174–184. https://doi.org/10.1093/geronb/gbp130

Turiano, N. A., Chapman, B. P., Gruenewald, T. L., & Mroczek, D. K. (2015). Personality and the leading behavioral contributors of mortality. *Health Psychology*, *34*(1), 51–60. https://doi.org/10.1037/hea0000038

Tuttle, C. S. L., Thang, L. A. N., & Maier, A. B. (2020). Markers of inflammation and their association with muscle strength and mass: A systematic review and meta-analysis. *Ageing Research Reviews*, *64*, Article 101185. https://doi.org/10.1016/j.arr.2020.101185

Vainik, U., Dagher, A., Realo, A., Colodro-Conde, L., Mortensen, E. L., Jang, K., Juko, A., Kandler, C., Sørensen, T. I. A., & Mõttus, R. (2019). Personality-obesity associations are driven by narrow traits: A meta-analysis. *Obesity Reviews*, *20*(8), 1121–1131. https://doi.org/10.1111/obr.12856

Veronese, N., Stubbs, B., Trevisan, C., Bolzetta, F., De Rui, M., Solmi, M., Sartori, L., Musacchio, E., Zambon, S., Perissinotto, E., Crepaldi, G., Manzato, E., & Sergi, G. (2016). What physical performance measures predict incident cognitive decline among intact older adults? A 4.4 year follow up study. *Experimental Gerontology*, *81*, 110–118. https://doi.org/10.1016/j.exger.2016.05.008

Volpato, S., Cavalieri, M., Sioulis, F., Guerra, G., Maraldi, C., Zuliani, G., Fellin, R., & Guralnik, J. M. (2011). Predictive value of the Short Physical Performance Battery following hospitalization in older patients. *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences*, *66*(1), 89–96. https://doi.org/10.1093/gerona/glq167

Wallace, R., Herzog, A. R., Ofstedal, M. B., Steffick, D., Fonda, S., & Langa, K. (2000). *Documentation of affective functioning measures in the health and retirement study*. Survey Research Center, University of Michigan.

Wang, D. X. M., Yao, J., Zirek, Y., Reijnierse, E. M., & Maier, A. B. (2020). Muscle mass, strength, and physical performance predicting activities of daily living: A meta-analysis. *Journal of Cachexia, Sarcopenia and Muscle*, *11*(1), 3–25. https://doi.org/10.1002/jcsm.12502

Welch, S. A., Ward, R. E., Beauchamp, M. K., Leveille, S. G., Travison, T., & Bean, J. F. (2021). The Short physical performance battery (SPPB): A quick and useful tool for fall risk stratification among older primary care patients. *Journal of the American Medical Directors Association*, *22*(8), 1646–1651. https://doi.org/10.1016/j.jamda.2020.09.038

Weston, S. J., Hill, P. L., & Jackson, J. J. (2015). Personality traits predict the onset of disease. *Social Psychological and Personality Science*, *6*(3), 309–317. https://doi.org/10.1177/1948550614553248

Willroth, E. C., Luo, J., Atherton, O. E., Weston, S. J., Drewelies, J., Batterham, P. J., Condon, D. M., Gerstorf, D., Huisman, M., Spiro, A., Mroczek, D. K., & Graham, E. K. (2023). Personality traits and health care use: A coordinated analysis of 15 international samples. *Journal of Personality and Social Psychology*, *125*(3), 629–648. https://doi.org/10.1037/pspp0000465

Wright, A. J., & Jackson, J. J. (2023). Do changes in personality predict life outcomes? *Journal of Personality and Social Psychology*, *125*(6), 1495–1518. https://doi.org/10.1037/pspp0000472

Zimprich, D., Allemand, M., & Lachman, M. E. (2012). Factorial structure and age-related psychometrics of the MIDUS personality adjective items across the life span. *Psychological Assessment*, *24*(1), 173–186. https://doi.org/10.1037/a0025265