

**This is a self-archived version of an original article. This version may differ from the original in pagination and typographic details.**

**Author(s):** Stephan, Yannick; Sutin, Angelina R.; Canada, Brice; Deshayes, Maxime; Kekäläinen, Tiia; Terracciano, Antonio

**Title:** Five-factor model personality traits and grip strength : Meta-analysis of seven studies

**Year:** 2022

**Version:** Accepted version (Final draft)

**Copyright:** © 2022 Elsevier Inc. All rights reserved.

**Rights:** CC BY-NC-ND 4.0

**Rights url:** <https://creativecommons.org/licenses/by-nc-nd/4.0/>

**Please cite the original version:**

Stephan, Y., Sutin, A. R., Canada, B., Deshayes, M., Kekäläinen, T., & Terracciano, A. (2022). 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>

RUNNING HEAD: PERSONALITY AND GRIP STRENGTH

*In press at Journal of Psychosomatic Research*

Five-Factor Model Personality Traits and Grip Strength: Meta-analysis of Seven Studies

Yannick Stephan<sup>1\*</sup>, PhD, Angelina R. Sutin<sup>2</sup>, PhD, Brice Canada<sup>3</sup>, PhD, Maxime Deshayes<sup>4</sup>,

Tiia Kekäläinen PhD<sup>5</sup>, Antonio Terracciano<sup>6</sup>, PhD

<sup>1</sup> Euromov, University of Montpellier, France

<sup>2</sup>Department of Behavioral Sciences and Social Medicine, College of Medicine, Florida State

University, USA

<sup>3</sup>L-Vis, University Lyon 1, France

<sup>4</sup> University of Nîmes, France

<sup>5</sup>Gerontology Research Center and Faculty of Sport and Health Sciences, University of

Jyväskylä, Finland

<sup>6</sup>Department of Geriatrics, College of Medicine, Florida State University, USA

**Word count:** 4275 words

Correspondence concerning this article should be addressed to Yannick Stephan, Euromov, University of Montpellier, UFRSTAPS, 700, Avenue du Pic St Loup, 34090 Montpellier, France. E-mail: [yannick.stephan@umontpellier.fr](mailto:yannick.stephan@umontpellier.fr)

Angelina R. Sutin: [angelina.sutin@med.fsu.edu](mailto:angelina.sutin@med.fsu.edu)

Brice Canada: [brice.canada@univ-lyon1.fr](mailto:brice.canada@univ-lyon1.fr)

Maxime Deshayes: [maxime.deshayes@unimes.fr](mailto:maxime.deshayes@unimes.fr)

Tiia Kekäläinen: [tiia.m.kekalainen@jyu.fi](mailto:tiia.m.kekalainen@jyu.fi)

Antonio Terracciano: [antonio.terracciano@med.fsu.edu](mailto:antonio.terracciano@med.fsu.edu)

**Conflicts of Interest:** None

**Financial Support:** The research reported in this publication 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.

**Acknowledgments**

The Health and Retirement Study (HRS) is sponsored by the National Institute on Aging (NIA-U01AG009740) and conducted by the University of Michigan. HRS data is publicly available at <http://hrsonline.isr.umich.edu/>. 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 2R01AG7644-01A1 and 2R01AG017644] and a consortium of UK government departments coordinated by the Office for National Statistics. ELSA data are available from the UK Data Service (UKDS, <https://www.ukdataservice.ac.uk/>). 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. NHATS data are available for public download at: <http://www.nhats.org>. The United Kingdom Household Longitudinal Study Understanding Society is an initiative funded by the Economic and Social Research Council and various Government Departments, with scientific leadership by the Institute for Social and Economic Research, University of Essex, and survey delivery by NatCen Social Research and Kantar Public. The research data are distributed by the UK Data Service and are available at <https://www.ukdataservice.ac.uk>. 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. A public use file of data is available at <http://www.ssc.wisc.edu/wlsresearch/data/>.

**Abstract**

**Objective.** To examine the association between Five-Factor Model personality traits and grip strength. **Method.** Adults aged 16 to 104 years old ( $N > 40,000$ ) were from the Health and Retirement Study, the Midlife in the United States Study, The English Longitudinal Study of Ageing, the National Health and Aging Trends Survey, the United Kingdom Household Longitudinal Study, and the Wisconsin Longitudinal Study graduate and sibling samples. Participants had data on personality traits, demographic factors, grip strength, and mediators such as depressive symptoms, physical activity, body mass index (BMI), and c-reactive protein (CRP). **Results.** Across all samples and a meta-analysis, higher neuroticism was related to lower grip strength (meta-analytic estimate:  $-0.07$ , 95%CI:  $-0.075$ ;  $-0.056$ ). Higher extraversion ( $0.04$ , 95%CI:  $0.022$ ;  $0.060$ ), openness ( $0.05$ , 95%CI:  $0.032$ ;  $0.062$ ), and conscientiousness ( $0.05$ , 95%CI:  $0.04$ ;  $0.065$ ) were associated with higher grip strength across most samples and the meta-analysis. Depressive symptoms were the most consistent mediators between neuroticism and grip strength. Depressive symptoms and physical activity partly mediated the associations with extraversion, openness, and conscientiousness. Lower CRP partly mediated the association with conscientiousness. Sex moderated the associations for extraversion, openness, and conscientiousness, with stronger associations among males. Age moderated the neuroticism association, with stronger associations among younger individuals. **Conclusion.** This study provides replicable evidence that personality is related to grip strength and identifies potential moderators and mediators of these associations. Overall, higher neuroticism is a risk factor for low grip strength, whereas high extraversion, openness, and conscientiousness may be protective.

**Keywords:** personality, neuroticism, Five-Factor Model, grip strength, health, aging.

## 1. Introduction

As indexed by performance-based grip strength measures, muscle function has critical implications for a range of health outcomes. Indeed, poor grip strength is indicative of the frailty syndrome [1], and it is associated with being able to engage in fewer independent activities of daily living (IADL) [2] and a higher risk of falls [3]. Furthermore, lower handgrip strength is predictive of a higher risk of cognitive decline, incident dementia, and all-cause mortality [4, 5]. There is a need to better understand factors related to grip strength. Numerous demographic, behavioral, and health-related factors have been related to grip strength performance [6]. The present study advances knowledge on psychological factors related to grip strength by examining whether individual differences in personality traits (i.e., enduring patterns of thoughts, feelings, and behaviors) are associated with grip strength.

According to the Five-Factor Model (FFM) [7], personality can be organized into five traits: Neuroticism (the tendency to experience negative emotions and distress), extraversion (the propensity to be sociable and to experience positive emotions), openness (the tendency to be curious and to search for variety), agreeableness (the tendency to be cooperative and altruistic), and conscientiousness (the propensity to be self-disciplined and organized). A growing body of research supports theoretical models that link personality to health across adulthood [8,9]. Replicable associations have been found across a range of health-related outcomes, including physical activity [10] and smoking [11], functional and biological markers [12,13], self-rated health [14], and incident diseases, such as major depression [15], Alzheimer's disease [16] and Parkinson's disease [17]. Furthermore, personality traits have been consistently related to mortality risk [18].

There is both indirect and direct evidence for the association between personality and muscular strength. Indeed, higher neuroticism and lower extraversion, openness, agreeableness, and conscientiousness have been related to higher frailty [19], which is characterized in part by

worse grip strength. Personality traits have also been directly related to muscle strength, but with relatively inconsistent findings. Higher neuroticism, for example, has been related to lower grip strength [20- 22], although one study indicated that this association is only apparent among men [23]. Some studies found an association between higher extraversion and higher grip strength [21, 22], whereas others observed this association only among men [20,23]. Higher openness has been associated with higher grip strength in one study [21], but not in others [20,23]. Higher agreeableness was related to higher handgrip only among women [23], whereas other research found no association [20]. Finally, conscientiousness has been associated with higher grip strength in some studies [21, 24], but not in others [20,23]. Therefore, the association between personality and grip strength remains relatively unclear. Some research relied on relatively small samples or did not examine all five personality traits. To our knowledge, there has been no large-scale study that examined the association between personality and grip strength. Past research has reported some moderation of the association between neuroticism, extraversion, and agreeableness and grip strength by sex, but not for openness and conscientiousness. However, the findings have been inconsistent and only found in a limited number of studies, perhaps due to low power. Furthermore, no research has yet tested potential mediators of the associations between personality traits and grip strength.

The present study examined the association between personality and grip strength using seven samples of adults from large cohorts. Based on past research [21,22,24], it was hypothesized that higher neuroticism would be related with lower grip strength, whereas higher extraversion and conscientiousness would be associated with higher grip strength. Based on existing studies [20,23], no associations were expected for openness and agreeableness. Because body mass index (BMI), physical activity, depressive symptoms, and protein c-reactive (CRP) have been related to both grip strength [25-28] and personality [10, 12, 29, 30], they were tested as mediators of the association between personality and grip strength. Finally,

this study also tested whether the association between personality and grip strength varied according to age and sex.

## **2. Method**

### *2.1. Participants*

Participants were from seven de-identified publicly available datasets: Health and Retirement Study (HRS), Midlife in the United States study (MIDUS), English Longitudinal Study of Ageing (ELSA), National Health and Aging Trends Survey (NHATS), United Kingdom Household Longitudinal Study (UKHLS), and the Wisconsin Longitudinal Study graduate (WLSG) and sibling (WLSS) samples. All participants provided written informed consent approved by each study's Institutional Review Board. Participants were included in the present study if they had complete data on the five personality traits, grip strength, and demographic factors. Descriptive statistics for the seven samples are presented in Table 1.

The HRS is a nationally representative longitudinal study of Americans 50 years and older and their spouse. Data on demographic factors, personality, and grip strength were obtained from half of the sample in 2006 and from the other half in 2008. With both waves combined, a total of 10,808 participants aged from 50 to 104 years old (58% women, mean age=68.42, SD=9.75) were included in the present study.

The MIDUS is a longitudinal study of non-institutionalized, English-speaking US adults. The present study used the second wave (2004-2006, MIDUS II). A total of 991 individuals aged from 34 to 81 years old had complete data on personality, demographic factors, and grip strength (55% women, Mean age= 55.36, SD= 11.80)

ELSA is a representative cohort of men and women living in England aged 50 years and older. Personality and demographic factors were obtained at Wave 5 (2010-2011), and grip strength was available in Wave 6 (2012-2013). Complete data were obtained from a total of 5,988 individuals aged from 50 to 89 years (55% women, mean age = 66.21, SD = 8.26)

The NHATS is a nationally representative longitudinal study of Medicare enrollees aged 65 years and older. Personality, grip strength, and demographic data were obtained in 2013 for one-third of the sample, and in 2014 for a second third. With these waves combined, the final analyzed sample was composed of 2,263 participants aged from 67 to 103 years (59% women, mean age = 79.26, SD = 7.41).

The UKHLS is a nationally representative panel study of UK households. Data on personality traits and demographic factors were obtained from the third wave (2011-2013), and data on grip strength were available at either Wave 2 (2010-2012) or Wave 3. Complete data were obtained from a total of 13,807 participants aged from 16 to 99 years (56% women, Mean age: 50.02, SD: 17.35).

The WLS is a long-term study of a random sample of 10,317 men and women who graduated from Wisconsin high schools in 1957 (WLSG). Complete data on personality, demographic factors, and grip strength were obtained in 2011 from 4,753 participants aged from 70 to 74 years old (54% women, mean age = 71.19, SD = 0.91). The WLS also includes a sample of selected siblings of some of the graduates (WLSS). Data were obtained in 2011 from 2,520 participants aged from 40 to 92 years old (54% women, mean age = 69.23, SD = 6.67).

## *2.2. Measures*

### *2.2.2. Personality*

All seven studies used validated measures of the five major personality traits. A 26-item version of the Midlife Development Inventory (MIDI) [31] was used in the HRS, MIDUS, ELSA, and a 10-item version was used in the NHATS. Participants were asked to rate how well adjectives representing the five traits described themselves on a scale ranging from 1 (*not at all*) to 4 (*a lot*). Example items are worrying (e.g., neuroticism), outgoing (e.g., extraversion), creative (e.g., openness), caring (e.g., agreeableness), and organized (e.g., conscientiousness).



Personality was assessed using a 15-item version of the Big Five Inventory (BFI) [32] in the UKHLS and a 29-item version [33] was used in the WLSG and WLSS. Participants were presented with the sentence “I see myself as someone who...”, and were asked to rate items assessing neuroticism (e.g., worries a lot), extraversion (e.g., is outgoing, sociable), openness (e.g., is original, comes up with new ideas), agreeableness (e.g., is considerate and kind to almost everyone), and conscientiousness (e.g., does things efficiently). The response scale was from 1 (*does not apply to me at all*) to 7 (*applies to me perfectly*) in the UKHLS and from 1 (*disagree strongly*) to 6 (*agree strongly*) in WLSG and WLSS.

### 2.2.3. Grip strength.

Grip strength was measured in kg using a dynamometer. In the HRS, NHATS and WLS samples, the best of two trials using the dominant hand was used, whereas the best of three trials with the dominant hand was used in ELSA, UKHLS, and MIDUS.

### 2.2.4. Mediators.

BMI, physical activity, depressive symptoms, and CRP were tested as mediators of the association between personality and grip strength. BMI was computed as  $\text{kg/m}^2$  based on staff-assessed weight and height in HRS, ELSA, UKHLS, WLSG, WLSS, and MIDUS and on self-reported height and weight in NHATS. Measures of physical activity were available in six out of seven samples (UKHLS did not include physical activity at wave 3). In the HRS and ELSA, the mean of two items that asked how often individuals participated in vigorous and moderate physical activity on a scale from 1 (hardly ever or never) to 4 (more than once a week) was computed. In the MIDUS, participants indicated the frequency of their vigorous and moderate leisure physical activity during both the summer and winter months on a scale from 1 (never) to 6 (several times a week or more). Items were averaged. In the NHATS, participants indicated whether they ever go walking for exercise (yes/no) and whether they ever spent time on vigorous activities in the last month (yes/no). The sum of the two items was computed. In the

WLS samples, four items on the hours per month spent doing vigorous or light physical activities, both alone and with others during the last year were used. The answers to these items were summed. Depressive symptoms were measured in the seven samples. The 20-item version Center for Epidemiologic Studies Depression Scale (CES-D) [34] was used in both WLS samples. Participants were asked to indicate on how many days during the past week did they experience symptoms of depression. Answers were summed across items with higher scores representing higher depressive symptoms. An 8-item version of the CES-D was used in the HRS and ELSA [35]. Participants indicated whether they experienced eight symptoms during the past week using a yes/no format. Answers were summed. The Composite International Diagnostic Interview Short Form (CIDI-SF) [36] was used in the MIDUS. A yes/no format was used to assess participants' experience of depressive symptoms that lasted for two weeks of the last 12 months. A composite score was computed with higher values indicating higher depressive symptoms. The Patient Health Questionnaire-2 (PHQ-2) [37] was used in the NHATS. Participants were asked 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 on a scale from 1 (not at all) to 4 (nearly everyday). Answers to the two items were averaged, with higher scores indicating higher depressive symptoms. The 12-item General Health Questionnaire (GHQ-12) [38] was used in the UKHLS. Participants indicated whether they experienced 12 symptoms during the last week. Answers were summed across items, with higher scores indicating higher symptoms. Finally, CRP was obtained from blood samples assayed in HRS, ELSA, MIDUS, and UKHLS. Due to the skewed distribution of CRP, a natural log was performed.

#### *2.2.5. Covariates.*

Age, sex (coded as 1 for male and 0 for female), and education were controlled for in the seven samples. Race (coded as 1 for white and 0 for other) was controlled for in the HRS, MIDUS,

ELSA, UKHLS, and NHATS. Education was measured using a scale from 1 (no grade school) to 12 (doctoral level degree) in the 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 the NHATS, and from 0 (none) to 16 (higher degree) in the UKHLS, whereas it was measured in years in the WLSG, the WLSS, and the HRS.

### *2.3.Data Analysis*

In each sample, regression analysis was used to examine the association between personality and grip strength. Grip strength was regressed on each personality trait, controlling for age, sex, education in all studies and race in the HRS, ELSA, MIDUS, UKHLS and NHATS. Personality traits were analyzed separately. The estimates from these analyses were combined in a random effect meta-analysis conducted with the JAMOVI software. Additional analyses examined whether age and sex moderated the association between personality and grip strength by including an interaction term for each of the five factors and age and sex. These results were combined in a random effect meta-analysis.

BMI, physical activity, depressive symptoms, and CRP were tested as mediators using bootstrap analysis with 5,000 bootstrapped samples and 95% bias-corrected confidence intervals. The mediators were tested simultaneously.

### **3. Results**

As hypothesized, higher neuroticism was associated with lower grip strength (see Table 2). This association was observed in each of the seven samples and the meta-analysis. Also consistent with expectations, higher extraversion and conscientiousness were both related to higher grip strength (Table 2). These associations were significant in five samples for extraversion (HRS, ELSA, NHATS, UKHLS, WLSG) and six samples for conscientiousness (HRS, ELSA, NHATS, UKHLS, WLSG, WLSS). The meta-analysis supported this pattern of

associations (Table 2). Unexpectedly, higher openness was associated with higher grip strength in five out of seven samples (HRS, ELSA, NHATS, UKHLS, WLSG) and the meta-analysis (Table 2). There was little replicable evidence for an association between agreeableness and grip strength. Effect sizes for the difference between individuals with high (one standard deviation above the mean) and low (one standard deviation below the mean) level on each trait ranged from  $d = .12$  to  $d = .24$  for neuroticism, from  $d = .06$  to  $d = .20$  for extraversion, from  $d = .01$  to  $d = .23$  for openness, from  $d = .00$  to  $d = .11$  for agreeableness and from  $d = .09$  to  $d = .18$  for conscientiousness (Table 2). Across samples with significant associations between personality traits and grip strength, the average difference in strength (in kg) between individuals high and low on a particular trait was 1.99 kg for neuroticism, 1.41kg for extraversion, 1.58kg for conscientiousness, and 1.74kg for openness, adjusted for demographic factors.

Extraversion, conscientiousness, and openness were related to higher grip strength among both males and females, but the meta-analysis indicated that this association was stronger among males (Table 3). In contrast, the association between neuroticism and grip strength was similar for both males and females. Although the association between neuroticism and lower grip strength was observed across all ages, this association was stronger among relatively younger individuals (Table 4). There was, however, heterogeneity in the extent to which these interactions were related to grip strength across the seven samples.

Results from bootstrap analysis are in Table 5. The associations between personality and the mediators and between the mediators and grip strength are in supplementary material. The association between neuroticism and grip strength was partially mediated by depressive symptoms in all samples except the MIDUS (Table 5). This result suggested that higher neuroticism was associated with lower grip strength in part through its association with higher depressive symptoms. There was less consistent evidence for physical activity and BMI, and no mediating role of CRP between neuroticism and grip strength across the samples (Table 5).

Depressive symptoms also mediated the associations between extraversion (5 samples), openness (4 samples), and conscientiousness (6 samples) and grip strength (Table 5). These results suggest that higher extraversion, openness, and conscientiousness are related to higher grip strength in part through their association with lower depressive symptoms. In addition, the association between higher extraversion, openness, and conscientiousness and higher strength was mediated by their association with higher physical activity in three of the six samples with available data (Table 5). The association between higher conscientiousness and grip strength was also mediated by lower CRP in three out of four samples (Table 5). Finally, BMI mediated the association between extraversion and conscientiousness and grip strength in four out of the seven samples (Table 5). The examination of the association between conscientiousness and BMI and between BMI and grip strength (see supplementary Tables S1 and S2), suggests that higher conscientiousness is associated with lower BMI, which is related in turn to lower grip strength. Results for extraversion were mixed. In the HRS and ELSA, higher extraversion was related to lower BMI resulting in lower grip strength. However, in the NHATS and UKHLS, the pattern suggested that higher extraversion was related to higher grip strength through its association with higher BMI. The direct effect of personality traits on grip strength remained significant, which indicated partial mediation.

#### **4. Discussion**

The present study examined the association between personality and grip strength in seven samples that totaled more than 40,000 participants. To our knowledge, this is the largest sample to date to examine this association and the most systematic investigation of potential moderators and mediators. As expected, lower neuroticism and higher extraversion and conscientiousness were associated with more strength. Unexpectedly, higher openness was also related to higher grip strength. As expected, no association was found with agreeableness. These associations were robust because they were observed controlling for demographic factors,

across samples from different countries, different age ranges, and different personality measures. Furthermore, the study identified significant mediators, and some associations between personality and grip strength were moderated by sex and age, but differences among demographic groups were generally small.

Neuroticism was the most consistent personality correlate of grip strength. This finding extends previous research [21- 23] by showing replicable evidence for this association across seven samples and a meta-analysis. The psychological, behavioral, and biological profiles of individuals higher in neuroticism may explain their lower handgrip strength. Indeed, higher neuroticism is related to higher depressive symptoms [29], less physical activity [10] and higher BMI [39], which have been associated with lower grip strength in adulthood [25, 27, 28]. Partially consistent with this assumption, the association between higher neuroticism and lower grip strength was mediated in part by its association with higher depressive symptoms in six out of seven samples. However, there was less support for the mediating role of BMI and physical activity, and no mediation through CRP. This study thus suggests that the association between neuroticism and grip strength operates mostly through psychological factors such as depressive symptoms. Further, the partial mediation indicated that other pathways may operate in this association. For example, individuals with higher neuroticism report more chronic pain (40), which has been associated with lower grip strength [41], perhaps because pain interferes with test performance or its long-term impact on physical activity. Other health behaviors could also explain the association between neuroticism and muscle strength. For example, higher neuroticism is associated with smoking [11], which has been related to lower grip strength [42]. At the biological level, higher neuroticism is associated with higher risk of metabolic syndrome [43], which is related to lower grip strength [44].

As expected, higher extraversion and conscientiousness were associated with higher grip strength. The results also showed a positive association between openness and grip

strength. Previously published studies have reported positive associations [21, 22, 24], no associations [20, 23], or associations limited to males [20, 23] with these traits. The somewhat mixed findings of past studies could be due to limited power. Indeed, we found that the association between personality and grip strength had relatively small effect sizes. Extraverted, open, and conscientious individuals have more favorable psychological and behavioral profiles that may benefit muscular strength. In line with this hypothesis, additional analyses revealed that lower depressive symptoms and higher physical activity explained part of the association between these traits and grip strength. Furthermore, the biological profile of conscientious individuals is also reflected in their strength: Higher conscientiousness was related to higher grip strength in part through its association with lower CRP.

A surprising mediation of the conscientiousness-strength link through BMI was also found. Specifically, the indirect effect suggested that higher conscientiousness was related to lower BMI, which in turn was associated with lower grip strength. BMI conflates fat and lean mass, which complicates the interpretation of its associations with personality [45]. Recent research found that conscientiousness is related to lower relative fat mass [45], which may explain why this trait is consistently associated with lower BMI. In contrast, the association between higher BMI and higher grip strength observed in the present study may be driven by muscular mass. The same explanation applies to the mediational role of BMI in the extraversion-strength association observed in the HRS and ELSA. However, in NHATS and UKHLS, the pattern of association suggests that higher extraversion is associated with handgrip strength in part because this trait is related to higher BMI. In this case, the mediation may be indicative of the higher muscle mass of extraverted individuals that may lead to better strength. More research is needed using alternative markers of fat and lean mass as mediators of the association between personality and grip strength.

The psychological, behavioral, and biological factors only partially mediated the association between extraversion, openness and conscientiousness and muscular strength. Therefore, other factors may also mediate these associations. Extraversion, openness and conscientiousness are associated with lower fatigability [46], which is related to objective physical performances [47] and may extend to grip strength. Furthermore, both extraversion and conscientiousness are related to less chronic pain [40], which has been found to lead to higher grip strength [41]. The higher muscular strength related to openness may also be explained in part by its association with healthy eating behaviors [48]. At the biological level, higher conscientiousness is predictive of lower risk of metabolic syndrome [43], which may result in higher grip strength [44].

The present study contributes to existing models on the association between personality and health [9] by providing replicable evidence of an association with grip strength, a crucial marker of health and fitness. The identification of the link between personality and grip strength is informative about the relationship between personality and fitness and function. Indeed, higher grip strength is related to better cardiorespiratory fitness [49]. As such, this study helps identify the personality dispositions that are associated with greater energetic and functional resources. Furthermore, it contributes to a better understanding of the association between personality and a range of health-related outcomes. For example, higher neuroticism, lower extraversion, lower openness, and lower conscientiousness are related to higher risk of limitations in activities of daily living (IADL) [50]. Given that lower muscle strength is associated with higher risk of limitations in IADLs [51], grip strength may explain part of the association between these traits and worse IADL outcomes. Grip strength may likewise also figure in the pathway between personality and risk of dementia [4, 16].

The present study has several strengths, including seven large samples, the assessment of all five major dimensions of personality, the use of an objective performance measure of



muscle strength, the systematic analyses across samples and meta-analyses, and the testing of moderators and mediators informed by past research. However, there are also several limitations to consider. The observational design of the present study limits causal interpretations. Although personality may predict grip strength, for example, grip strength may also lead to changes in personality [22]. Longitudinal research is needed to disentangle temporal relations and examine the reciprocal associations between personality and muscle strength. In addition, all of the potential mediators were not available in samples. For example, physical activity was assessed in six and CRP was available in four out of the seven samples. Future research that includes additional mediators is needed to better understand the mechanisms linking personality to grip strength. For example, inflammatory factors other than CRP (e.g., Interleukin-6 or tumor necrosis factor-alpha), cognitive factors (e.g., executive functions), and additional health behaviors or brain-related measures may also be potential explanatory pathways of the relationship between personality and grip strength. Additional research may test whether the association between personality and grip strength could be explained by shared genetic factors or neurological factors that may be associated with both personality and grip strength. For example, stroke or neurodegenerative diseases like Parkinson's disease are related to both muscle functioning and personality, but these conditions are unlikely to fully explain the observed associations, especially at younger ages. Furthermore, this study relied on self-reported measures of physical activity, including some with dichotomous yes/no answer format, which could limit their reliability. The present study focused on the five broad dimensions of personality. Further research may examine the specific personality facets that are related to grip strength. Although this study includes cohorts from different countries such as the US and UK, additional research is needed to include more diverse samples from other world regions, such as Asia and Africa.

Despite these limitations, the present study identified replicable associations between personality and muscular strength, indexed by grip strength: Higher neuroticism was related to lower strength, whereas higher extraversion, openness, and conscientiousness were associated with higher strength. The association between personality and grip strength could allow the identification of individuals at risk of frailty, functional, and cognitive decline across adulthood. For example, individuals high on neuroticism, or with lower extraversion, openness, or conscientiousness may be targeted by physical activity programs to improve muscular strength to ultimately reduce decline in health. These individuals may also benefit from cognitive behavioral therapy or interventions that aim to reducing depressive symptoms, which may have a positive effect on grip strength. Personality traits are also potential moderators of treatment effects [52] and could eventually help tailor interventions that are more likely to be effective given a person's personality traits. Finally, interventions could be directed toward changing personality traits [53], for example reducing neuroticism or increasing conscientiousness, which may lead to better muscular strength.

### References

1. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, Seeman T, Tracy R, Kop WJ, Burke G, McBurnie MA; Cardiovascular Health Study Collaborative Research Group. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci.* 2001;56(3):M146-56.
2. Taekema DG, Gussekloo J, Maier AB, Westendorp RG, de Craen AJ. Handgrip strength as a predictor of functional, psychological and social health. A prospective population-based study among the oldest old. *Age Ageing.* 2010;39(3):331-7.
3. Xue QL, Walston JD, Fried LP, Beamer BA. Prediction of risk of falling, physical disability, and frailty by rate of decline in grip strength: the women's health and aging study. *Arch Intern Med.* 2011;171(12):1119-21.
4. Cui M, Zhang S, Liu Y, Gang X, Wang G. Grip Strength and the Risk of Cognitive Decline and Dementia: A Systematic Review and Meta-Analysis of Longitudinal Cohort Studies. *Front Aging Neurosci.* 2021;13:625551.
5. Leong DP, Teo KK, Rangarajan S, Lopez-Jaramillo P, Avezum A Jr, Orlandini A, Seron P, Ahmed SH, Rosengren A, Kelishadi R, Rahman O, Swaminathan S, Iqbal R, Gupta R, Lear SA, Oguz A, Yusuf K, Zatonska K, Chifamba J, Igumbor E, Mohan V, Anjana RM, Gu H, Li W, Yusuf S; Prospective Urban Rural Epidemiology (PURE) Study investigators. Prognostic value of grip strength: findings from the Prospective Urban Rural Epidemiology (PURE) study. *Lancet.* 2015;386(9990):266-73.
6. Hurst C, Murray JC, Granic A, Hillman SJ, Cooper R, Sayer AA, Robinson SM, Dodds RM. Long-term conditions, multimorbidity, lifestyle factors and change in grip strength over 9 years of follow-up: Findings from 44,315 UK biobank participants. *Age Ageing.* 2021;50(6):2222-2229.

7. McCrae, RR., and John, OP. An introduction to the five-factor model and its applications. *J Pers.*1992; 60(2): 175-215.
8. Strickhouser JE, Zell E, Krizan Z. Does personality predict health and well-being? A metasynthesis. *Health Psychol.* 2017;36(8):797-810.
9. Friedman HS, Kern ML. Personality, well-being, and health. *Annu Rev Psychol.* 2014;65:719-42.
10. Sutin, AR, Stephan, Y, Luchetti, M, Artese, A, Oshio, A, and Terracciano, A. The five factor model of personality and physical inactivity: A meta-analysis of 16 samples. *J Res Pers.* 2016; 63: 22-28.
11. Hakulinen C, Hintsanen M, Munafò MR, Virtanen M, Kivimäki M, Batty GD, Jokela M. Personality and smoking: individual-participant meta-analysis of nine cohort studies. *Addiction.* 2015;110(11):1844-52.
12. Luchetti M, Barkley JM, Stephan Y, Terracciano A, Sutin AR. Five-factor model personality traits and inflammatory markers: new data and a meta-analysis. *Psychoneuroendocrinology.* 2014 ;50:181-93.
13. Stephan Y, Sutin AR, Luchetti M, Canada B, Terracciano A. Personality and HbA1c: Findings from six samples. *Psychoneuroendocrinology.* 2020;120:104782.
14. Stephan Y, Sutin AR, Luchetti M, Hognon L, Canada B, Terracciano A. Personality and self-rated health across eight cohort studies. *Soc Sci Med.* 2020;263:113245.
15. Kendler KS, Gatz M, Gardner CO, Pedersen NL. Personality and major depression: a Swedish longitudinal, population-based twin study. *Arch Gen Psychiatry.* 2006;63(10):1113-20.
16. Aschwanden D, Strickhouser JE, Luchetti M, Stephan Y, Sutin AR, Terracciano A. Is personality associated with dementia risk? A meta-analytic investigation. *Ageing Res Rev.* 2021;67:101269.

17. Terracciano A, Aschwanden D, Stephan Y, Cerasa A, Passamonti L, Toschi N, Sutin AR. Neuroticism and Risk of Parkinson's Disease: A Meta-Analysis. *Mov Disord.* 2021;36(8):1863-1870.
18. Graham EK, Rutsohn JP, Turiano NA, Bendayan R, Batterham PJ, Gerstorf D, Katz MJ, Reynolds CA, Sharp ES, Yoneda TB, Bastarache ED, Elleman LG, Zelinski EM, Johansson B, Kuh D, Barnes LL, Bennett DA, Deeg DJH, Lipton RB, Pedersen NL, Piccinin AM, Spiro A 3rd, Muniz-Terrera G, Willis SL, Schaie KW, Roan C, Herd P, Hofer SM, Mroczek DK. Personality Predicts Mortality Risk: An Integrative Data Analysis of 15 International Longitudinal Studies. *J Res Pers.* 2017;70:174-186.
19. Stephan Y, Sutin AR, Canada B, Terracciano A. Personality and Frailty: Evidence From Four Samples. *J Res Pers.* 2017;66:46-53.
20. Kerry N, Murray DR. Strong personalities: Investigating the relationships between grip strength, self-perceived formidability, and Big Five personality traits. *Pers Individ Dif.* 2018 ; 131 : 216–221.
21. Mueller S, Wagner J, Drewelies J, Duezel S, Eibich P, Specht J, Demuth I, Steinhagen-Thiessen E, Wagner GG, Gerstorf D. Personality development in old age relates to physical health and cognitive performance: Evidence from the Berlin Aging Study II. *J Res Pers.* 2016; 65 : 94–108.
22. Mueller S, Wagner J, Smith J, Voelkle MC, Gerstorf D. The interplay of personality and functional health in old and very old age: Dynamic within-person interrelations across up to 13 years. *J Pers Soc Psychol.* 2018;115(6):1127-1147.
23. Fink B, Weege B, Pham MN, Shackelford TK. Handgrip strength and the Big Five personality factors in men and women. *Personal. Individ. Dif.* 2016 ; 88 : 175–177.
24. Sutin AR, Stephan Y, Terracciano A. Facets of conscientiousness and objective markers of health status. *Psychol Health.* 2018;33(9):1100-1115.

25. Dodds R, Kuh D, Aihie Sayer A, Cooper R. Physical activity levels across adult life and grip strength in early old age: updating findings from a British birth cohort. *Age Ageing*. 2013;42(6):794-8.
26. Hamer M, Molloy GJ. Association of C-reactive protein and muscle strength in the English Longitudinal Study of Ageing. *Age (Dordr)*. 2009;31(3):171-7.
27. Lian Y, Wang GP, Chen GQ, Jia CX. Bidirectional Associations between Handgrip Strength and Depressive Symptoms: A Longitudinal Cohort Study. *J Am Med Dir Assoc*. 2021;22(8):1744-1750.e1.
28. Stenholm S, Sallinen J, Koster A, Rantanen T, Sainio P, Heliövaara M, Koskinen S. Association between obesity history and hand grip strength in older adults--exploring the roles of inflammation and insulin resistance as mediating factors. *J Gerontol A Biol Sci Med Sci*. 2011;66(3):341-8.
29. Hakulinen C, Elovainio M, Pulkki-Råback L, Virtanen M, Kivimäki M, Jokela M. Personality and depressive symptoms: Individual participant meta-analysis of 10 cohort studies. *Depress Anxiety*. 2015;32(7):461-70.
30. Jokela M, Hintsanen M, Hakulinen C, Batty GD, Nabi H, Singh-Manoux A, Kivimäki M. Association of personality with the development and persistence of obesity: a meta-analysis based on individual-participant data. *Obes Rev*. 2013;14(4):315-23.
31. Zimprich D, Allemand M, Lachman ME. Factorial structure and age-related psychometrics of the MIDUS personality adjective items across the life span. *Psychol Assess* 2012; 24(1) : 173-186.
32. Soto CJ, John OP. Short and extra-short forms of the Big Five Inventory–2: The BFI-2-S and BFI-2-XS. *J Res Pers*. 2017 ; 68 : 69–81.

33. John OP, Donahue EM, Kentle RL. The Big Five Inventory—Versions 4a and 54. Berkeley, CA: Institute of Personality and Social Research, University of California, 1991.
34. Radloff LS. The CES-D scale: A self-report depression scale for research in the general population. *Appl Psychol Meas.* 1977; 1: 385-401.
35. Wallace R, Herzog AR, Ofstedal MB, Steffick D, Fonda S, Langa K. Documentation of affective functioning measures in the Health and Retirement Study. Survey Research Center, University of Michigan, Ann Arbor, MI, 2000
36. Kessler RC, Andrews G, Mroczek D, Ustun TB, Wittchen HU. The World Health Organization Composite International Diagnostic Interview Short Form (CIDI-SF). *Int J Methods Psychiatr Res.* 1998; 7: 171-85.
37. Kroenke K, Spitzer RL, Williams JB. The Patient Health Questionnaire-2: Validity of a two-item depression screener. *Medical Care.* 2003; 41:1284–92.
38. Goldberg DP. *The Detection of Psychiatric Illness by Questionnaire.* Oxford University Press: London, 1972.
39. Sutin AR, Terracciano A. Personality traits and body mass index: Modifiers and mechanisms. *Psychol Health.* 2016;31(3):259-75.
40. Sutin AR, Stephan Y, Luchetti M, Terracciano A. The prospective association between personality traits and persistent pain and opioid medication use. *J Psychosom Res.* 2019;123:109721.
41. Manickaraj N, Bisset LM, Devanaboyina VSPT, Kavanagh JJ. Chronic pain alters spatiotemporal activation patterns of forearm muscle synergies during the development of grip force. *J Neurophysiol.* 2017;118(4):2132-2141.

42. Al-Obaidi S, Al-Sayegh N, Nadar M. Smoking impact on grip strength and fatigue resistance: implications for exercise and hand therapy practice. *J Phys Act Health*. 2014;11(5):1025-31.
43. Sutin AR, Costa PT Jr, Uda M, Ferrucci L, Schlessinger D, Terracciano A. Personality and metabolic syndrome. *Age (Dordr)*. 2010;32(4):513-519.
44. Sayer AA, Syddall HE, Dennison EM, Martin HJ, Phillips DI, Cooper C, Byrne CD; Hertfordshire Cohort. Grip strength and the metabolic syndrome: findings from the Hertfordshire Cohort Study. *QJM*. 2007;100(11):707-13.
45. Arumäe K, Mõttus R, Vainik U. Beyond BMI: Personality traits' associations with adiposity and metabolic rate. *Physiol Behav*. 2022 ; 246 : 113703
46. Chan T, Wanigatunga AA, Terracciano A, Carlson MC, Bandeen-Roche K, Costa PT, Simonsick EM, Schrack JA. Traits and treadmills: Association between personality and perceived fatigability in well-functioning community-dwelling older adults. *Psychol Aging*. 2021;36(6):710-717.
47. Simonsick EM, Schrack JA, Santanasto AJ, Studenski SA, Ferrucci L, Glynn NW. Pittsburgh Fatigability Scale: One-Page Predictor of Mobility Decline in Mobility-Intact Older Adults. *J Am Geriatr Soc*. 2018;66(11):2092-2096.
48. Weston SJ, Edmonds GW, Hill PL. Personality traits predict dietary habits in middle-to-older adults. *Psychol Health Med*. 2020;25(3):379-387.
49. Pratt J, De Vito G, Narici M, Segurado R, Dolan J, Conroy J, Boreham C. Grip strength performance from 9431 participants of the GenoFit study: normative data and associated factors. *Geroscience*. 2021;43(5):2533-2546.
50. Canada B, Stephan Y, Fundenberger H, Sutin AR, Terracciano A. Cross-sectional and prospective association between personality traits and IADL/ADL limitations. *Psychol Aging*. 2021;36(3):309-321.



51. Wang DXM, Yao J, Zirek Y, Reijnierse EM, Maier AB. Muscle mass, strength, and physical performance predicting activities of daily living: a meta-analysis. *J Cachexia Sarcopenia Muscle*. 2020;11(1):3-25.
52. Marr C, Vaportzis E, Dewar M, Gow AJ. Investigating associations between personality and the efficacy of interventions for cognitive ageing: A systematic review. *Arch Gerontol Geriatr*. 2020;87:103992.
53. Roberts BW, Luo J, Briley DA, Chow PI, Su R, Hill PL. A systematic review of personality trait change through intervention. *Psychol Bull*. 2017;143(2):117-141.

Table 1.  
*Baseline Characteristics of the Samples*

Variables	HRS		MIDUS		ELSA		NHATS		UKHLS		WLSG		WLSS	
	<i>M/%</i>	<i>SD</i>	<i>M/%</i>	<i>SD</i>	<i>M/%</i>	<i>SD</i>	<i>M/%</i>	<i>SD</i>	<i>M/%</i>	<i>SD</i>	<i>M/%</i>	<i>SD</i>	<i>M/%</i>	<i>SD</i>
Age (Years)	68.42	9.75	55.36	11.80	66.21	8.26	79.26	10.59	50.02	17.35	71.20	0.91	69.23	6.67
Sex (% women)	58%	-	55%	-	55%	-	58%	-	56%	-	54%	-	54%	-
Race (% White)	86%	-	95%	-	98%	-	74%	-	94%	-	100%	-	100%	-
Education	12.91	2.90	7.75	2.45	4.24	2.22	5.31	2.27	7.04	6.20	13.86	2.39	14.11	2.59
Neuroticism	2.03	0.60	2.01	0.63	2.09	0.59	2.19	0.85	3.54	1.44	3.02	0.92	3.03	0.93
Extraversion	3.20	0.55	3.13	0.57	3.16	0.55	3.15	0.74	4.62	1.32	3.79	0.87	3.77	0.89
Openness	2.95	0.55	2.96	0.52	2.89	0.54	2.84	0.82	4.58	1.30	3.46	0.76	3.47	0.75
Agreeableness	3.53	0.47	3.43	0.51	3.51	0.48	3.58	0.53	5.64	1.02	4.80	0.71	4.79	0.71
Conscientiousness	3.37	0.47	3.40	0.45	3.30	0.49	3.24	0.71	5.51	1.09	4.74	0.71	4.72	0.71
Grip Strength	31.08	11.17	36.85	12.35	29.98	11.08	25.79	10.59	33.94	11.79	29.72	10.74	30.09	11.27

Note. HRS: N= 10,808; MIDUS: N= 991; ELSA: N= 5988; NHATS: N= 2263; UKHLS: N= 13807; WLSG: N= 4753; WLSS: N= 2520

Table 2.

*Summary of Regression Analysis Predicting Grip Strength from Personality Traits in the Seven Samples*

	Neuroticism		Extraversion		Openness		Agreeableness		Conscientiousness	
	$\beta$	d	$\beta$	d	$\beta$	d	$\beta$	d	$\beta$	d
HRS <sup>a</sup>	-0.07***(-0.08;-0.05)	.20	0.05***(0.04;0.06)	.14	0.05***(0.04;0.06)	.18	0.02***(0.010;0.03)	.07	0.05***(0.04;0.06)	.13
MIDUS <sup>a</sup>	-0.06**(-0.10; -0.02)	.18	-0.02(-0.06; -0.02)	.06	0.00(-0.04;0.04)	.02	-0.01(-0.05;0.04)	.11	0.01(-0.02;0.05)	.09
ELSA <sup>a</sup>	-0.06***(-0.08;-0.04)	.15	0.08***(0.06;0.09)	.20	0.08***(0.06;0.09)	.23	0.01(-0.00;0.03)	.05	0.06***(0.04;0.08)	.17
NHATS <sup>a</sup>	-0.05***(-0.08;-0.02)	.12	0.06***(0.03;0.08)	.17	0.06***(0.03;0.09)	.19	0.02(-0.00;0.05)	.05	0.04**(0.02;0.07)	.10
UKHLS <sup>a</sup>	-0.07***(-0.08;-0.05)	.24	0.03***(0.02;0.04)	.06	0.04***(0.03;0.06)	.11	-0.004(-0.02;0.008)	.02	0.07***(0.05;0.08)	.18
WLSG <sup>b</sup>	-0.06***(-0.08;-0.04)	.16	0.03*(0.005;0.05)	.07	0.04***(0.02;0.06)	.12	0.03*(0.006;0.05)	.06	0.04***(0.02;0.06)	.13
WLSS <sup>b</sup>	-0.06***(-0.09;-0.03)	.20	0.02(-0.009;0.04)	.06	0.02(-0.007;0.05)	.08	0.006(-0.02;0.03)	.00	0.04**(0.02;0.07)	.15
Random Effect	-0.07*** (-0.075;-0.056)		0.04*** (0.022;0.060)		0.05*** (0.032;0.062)		0.01 (-0.000;0.022)		0.05*** (0.04;0.065)	
I <sup>2</sup>	0		68.22		50.08		23.31		27.54	
Tau	0.00		0.02		0.014		0.006		0.009	

Note. HRS: N= 10,808; MIDUS: N= 991; ELSA: N= 5988; NHATS: N= 2263; UKHLS: N= 13807; WLSG: N= 4753; WLSS:N= 2520

$\beta$  = Standardized regression coefficient

<sup>a</sup> Adjusted for age, sex, education, and race

<sup>b</sup> Adjusted for age, sex, education

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

Table 3.

*Summary of Regression Analysis Predicting Grip Strength from the Interaction between Sex and Personality Traits in the Seven Samples*

	Neuroticism $\beta$	Extraversion $\beta$	Openness $\beta$	Agreeableness $\beta$	Conscientiousness $\beta$
HRS <sup>a</sup>	0.00(-0.02;0.02)	0.01(-0.002;0.03)	0.02**(0.009;0.04)	0.02(-0.002;0.03)	0.02*(0.003;0.03)
MIDUS <sup>a</sup>	0.02(-0.03; 0.08)	0.01(-0.05; 0.06)	0.01(-0.04;0.06)	0.01(-0.05;0.07)	-0.02(-0.08;0.03)
ELSA <sup>a</sup>	-0.004(-0.03;0.02)	0.01(-0.009;0.04)	0.04*** (0.02;0.06)	0.01(-0.01;0.04)	0.06*** (0.03;0.08)
NHATS <sup>a</sup>	0.008(-0.03;0.05)	0.03(-0.008;0.07)	0.04*(0.006;0.08)	-0.02(-0.06;0.02)	0.007(-0.03;0.04)
UKHLS <sup>a</sup>	-0.004(-0.02;0.01)	0.01(-0.002;0.03)	-0.004(-0.02;0.01)	-0.01(-0.03;0.003)	0.02*(0.0007;0.03)
WLSG <sup>b</sup>	-0.03(-0.05;0.002)	0.008(-0.02;0.03)	0.04** (0.01;0.06)	0.01(-0.01;0.04)	0.02(-0.006;0.05)
WLSS <sup>b</sup>	-0.03(-0.07;0.006)	-0.003(-0.04;0.03)	0.007(-0.03;0.04)	0.009(-0.03;0.05)	0.02(-0.01;0.06)
Random Effect	-0.006(-0.016;0.003)	0.01*(0.000;0.020)	0.02** (0.006;0.036)	0.004(-0.007;0.016)	0.02*** (0.011;0.037)
$I^2$	0.31	0	54.61	31.06	45.95
Tau	0.001	0.00	0.013	0.007	0.009

Note. HRS: N= 10,808; MIDUS: N= 991; ELSA: N= 5988; NHATS: N= 2263; UKHLS: N= 13807; WLSG: N= 4753; WLSS: N= 2520  
 $\beta$  = Standardized regression coefficient

<sup>a</sup> Adjusted for age, sex, education, race, and the main contribution of the trait

<sup>b</sup> Adjusted for age, sex, education, and the main contribution of the trait

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

Table 4.

*Summary of Regression Analysis Predicting Grip Strength from the Interaction between Age and Personality Traits in the Seven Samples*

	Neuroticism $\beta$	Extraversion $\beta$	Openness $\beta$	Agreeableness $\beta$	Conscientiousness $\beta$
HRS <sup>a</sup>	0.02**(0.007;0.03)	0.00(-0.003;0.02)	-0.01(-0.02;0.001)	0.02***(0.009;0.03)	-0.001(-0.01;0.01)
MIDUS <sup>a</sup>	-0.03(-0.07; 0.01)	0.00(-0.03; 0.04)	0.01(-0.04;0.06)	0.004(-0.04;0.04)	0.03(-0.01;0.07)
ELSA <sup>a</sup>	0.03*** (0.02;0.05)	-0.006(-0.02;0.01)	-0.01(-0.03;0.001)	0.01(-0.00;0.03)	0.002(-0.01;0.02)
NHATS <sup>a</sup>	0.01(-0.01;0.04)	-0.01(-0.04;0.02)	-0.008(-0.04;0.02)	-0.005(-0.03;0.02)	-0.0004(-0.03;0.03)
UKHLS <sup>a</sup>	0.06*** (0.04;0.07)	0.00(-0.01;0.01)	0.04*** (0.03;0.05)	-0.03*** (-0.04;-0.02)	-0.03*** (-0.04;-0.02)
WLSG <sup>b</sup>	0.02(-0.00;0.04)	-0.008(-0.03;0.01)	-0.009(-0.03;0.01)	-0.005(-0.02;0.02)	0.002(-0.02;0.02)
WLSS <sup>b</sup>	0.00(-0.02;0.03)	0.02(-0.005;0.05)	0.03(-0.002;0.05)	0.04** (0.009;0.06)	0.02(-0.007;0.05)
Random Effect	0.02** (0.006;0.041)	-0.001(-0.011;0.009)	0.006(-0.011;0.024)	0.003(-0.016;0.022)	0.002(-0.008;0.012)
	67.54	0	67.61	66.94	48.88
Tau	0.018	0.000	0.018	0.019	0.000

Note. HRS: N= 10,808; MIDUS: N= 991; ELSA: N= 5988; NHATS: N= 2263; UKHLS: N= 13807; WLSG: N= 4753; WLSS: N= 2520

$\beta$  = Standardized regression coefficient

<sup>a</sup> Adjusted for age, sex, education, race, and the main contribution of the trait

<sup>b</sup> Adjusted for age, sex, education, and the main contribution of the trait

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

Table 5. *Summary of Bootstrap Analysis*

Variables	Bootstrap Analysis <sup>a</sup>				
	Neuroticism	Extraversion	Openness	Agreeableness	Conscientiousness
<b>HRS</b>					
Depressive Symptoms	-.42(-.529;-.322)	.26(.206;.326)	.13(.093;.183)	.13(.090;.188)	.29(.221;.362)
BMI	-.03(-.067;-.003)	-.04(-.077;-.011)	.007(-.026;.041)	.03(-.005;.074)	-.13(-.176;-.084)
Physical activity	-.09 (-.128;-.062)	.18(.126;.232)	.12(.090;.171)	.07(.039;.104)	.17(.123;.221)
CRP	.003(-.011;.020)	.02(.007;.044)	.003(-.012;.022)	-.02(-.04;.002)	.04(.016;.061)
Direct effect <sup>b</sup>	-.04***	.03***	.04***	.01*	.03***
<b>MIDUS</b>					
Depressive Symptoms	-.12(-.374;.131)	.07(-.001;.214)	.01(-.035;.122)	.04(-.012;.195)	.09(-.003;.284)
BMI	-.03(-.191;.111)	-.18(-.394;-.017)	-.10(-.332;.059)	.14(-.022;.373)	-.18(-.448;-.0007)
Physical activity	-.05(-.178;.033)	.21(.086;.378)	.14(.037;.320)	.00(-.122;.125)	.07(-.041;.244)
CRP	.01(-.107;.128)	-.04(-.166;.063)	.02(-.113;.154)	.02(-.113;.154)	.16(.012;.366)
Direct effect <sup>b</sup>	-.06**	-.02	.00	-.01	.01
<b>ELSA</b>					
Depressive Symptoms	-.55(-.705;-.387)	.41(.294;.540)	.25(.172;.348)	.13(.064;.212)	.38(.264;.498)
BMI	-.01(-.039;.031)	-.05(-.101;-.014)	.02(-.018;.068)	.04(-.004;.087)	-.11(-.183;-.070)
Physical activity	-.09 (-.148;-.053)	.26(.180;.350)	.15(.096;.217)	-.00(-.059;.052)	.20(.135;.288)
CRP	.01(-.023;.044)	.02(-.008;.069)	-.01(-.049;.026)	-.03(-.071;.013)	.08(.035;.133)

PERSONALITY AND GRIP STRENGTH 30

Direct effect <sup>b</sup>	-.03**	.04***	.06***	.00	.03**
NHATS					
Depressive Symptoms	-.17(-.300;-.044)	.09(.026;.018)	.02(-.000;.066)	.13(.049;.233)	.10(.031;.180)
BMI	-.04(-.088;-.0016)	.06(.025;.126)	.00(-.041;.041)	.06(-.001;.131)	-.07(-.137;-.023)
Physical activity	-.02(-.087;.030)	.08(.026;.152)	.12(.059;.202)	.09(.003;.188)	.08(.017;.158)
CRP	-	-	-	-	-
Direct effect <sup>b</sup>	-.03	.04**	.04**	.01	.03*
UKHLS					
Depressive Symptoms	-.08(-.135;-.027)	.05(.032;.078)	.02(.009;.035)	.03(.012;.043)	.05(.030;.080)
BMI	-.03(-.051;-.004)	.04(.020;.067)	-.01(-.037;.014)	-.00(-.045;.023)	-.07(-.110;-.042)
Physical activity	-	-	-	-	-
CRP	-.00(-.015;.014)	-.01(-.030;.0005)	.00(-.012;.018)	.00(-.015;.025)	.03(.011;.050)
Direct effect <sup>b</sup>	-.05***	.02**	.05***	-.01	.06***
WLSG					
Depressive Symptoms	-.29(-.409;-.188)	.16(.107;.220)	.11(.073;.171)	.28(.195;.383)	.29(.192;.388)
BMI	-.01(-.027;.001)	.00(-.001;.020)	.00(-.005;.015)	-.01(-.033;.000)	-.03(-.074;.004)
Physical activity	-.001(-.014;.003)	.00(-.014;.029)	.00(-.005;.017)	.00(-.008;.022)	.00(-.018;.030)
CRP	-	-	-	-	-
Direct effect <sup>b</sup>	-.03**	.01	.02*	.00	.02
WLSS					
Depressive Symptoms	-.298(-.464;-.129)	.20(.115;.292)	.08(.032;.152)	.33(.208;.474)	.31(.154;.477)

PERSONALITY AND GRIP STRENGTH 31

BMI	.00(-.007; .014)	-.004(-.025;.004)	-.00(-.031;.005)	-.02(-.068;.016)	-.03(-.094; .024)
Physical activity	.00(-.009;.005)	-.00(-.017;.012)	-.00(-.022;.010)	-.00(-.038;.029)	-.00(-.048;.027)
CRP	-	-	-	-	-
Direct effect <sup>b</sup>	-.04*	-.00	.02	-.01	.03

Note. \* p<.05, \*\* p<.01, \*\*\* p< .001

<sup>a</sup> Bootstrap estimates and 95% bias-corrected confidence interval for indirect effects of personality traits on grip strength through depressive symptoms, BMI, physical activity and CRP, controlling for age, sex, education, and race (except for the WLSG and WLSS).

<sup>b</sup> Direct effect of personality traits on grip strength adjusted for mediators, age, sex, education, and race (except for the WLSG and WLSS); Coefficients are standardized regression coefficient

HRS: N= 8610; MIDUS: N= 980; ELSA: N= 4477; NHATS: N= 2177; UKHLS: N= 7730; WLSG: N= 4216; WLSS: N= 2251



