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RUNNING HEAD: PERSONALITY AND GRIP STRENGTH

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

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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 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 = .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 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.

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Table 1.
Baseline Characteristics of the Samples

	HRS		MIDUS		ELSA		NHATS		UKHLS		WLSG		WLSS	
Variables	*M/%*	*SD*	*M/%*	*SD*	*M/%*	*SD*	*M/%*	*SD*	*M/%*	*SD*	*M/%*	*SD*	*M/%*	*SD*
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	
	β	d	β	d	β	d	β	d	β	d
HRS[a]	-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[a]	-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[a]	-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 [a]	-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[a]	-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[b]	-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[b]	-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^2	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
β = Standardized regression coefficient
[a] Adjusted for age, sex, education, and race

[b] 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 β	Extraversion β	Openness β	Agreeableness β	Conscientiousness β
HRS[a]	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 [a]	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 [a]	-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[a]	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[a]	-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[b]	-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[b]	-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
β = Standardized regression coefficient
[a] Adjusted for age, sex, education, race, and the main contribution of the trait

[b] 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 β	Extraversion β	Openness β	Agreeableness β	Conscientiousness β
HRS[a]	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 [a]	-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 [a]	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[a]	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[a]	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[b]	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[b]	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
β = Standardized regression coefficient
[a] Adjusted for age, sex, education, race, and the main contribution of the trait

[b] 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[a]				
	Neuroticism	Extraversion	Openness	Agreeableness	Conscientiousness
HRS					
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[b]	-.04***	.03***	.04***	.01*	.03***
MIDUS					
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[b]	-.06**	-.02	.00	-.01	.01
ELSA					
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)

Direct effect[b]	-.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[b]	-.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[b]	-.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[b]	-.03**	.01	.02*	.00	.02
WLSS					
Depressive Symptoms	-.298(-.464;-.129)	.20(.115;.292)	.08(.032;.152)	.33(.208;.474)	.31(.154;.477)

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[b]	-.04*	-.00	.02	-.01	.03

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

[a] 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).
[b] 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