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Cross-Sectional and Prospective Association Between Personality Traits and IADL/ADL Limitations

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Prior research has shown that personality traits are associated with activities of daily living (ADLs) and instrumental ADLs (IADLs). To advance research on the psychological factors related to aging-related functional limitations, this study examined the relation between personality traits and both concurrent and incident functional limitations, tested whether these associations are similar across IADLs and ADLs, and tested potential mediators of these associations. Participants were drawn from eight longitudinal samples from the U.S., England, and Japan. Participants provided data on demographic variables, the five major personality traits, and on the Katz ADL-scale and Lawton IADL-scales. IADL/ADL limitations were assessed again 3–18 years later. A consistent pattern of associations was found between personality traits and functional limitations, with associations slightly stronger for IADLs than ADLs, and robust across samples that used different measures and from different cultural contexts. The meta-analysis indicated that higher neuroticism was related to a higher likelihood of concurrent and incident IADL/ADL limitations, and higher conscientiousness, extraversion, and openness were associated with lower risk. Higher agreeableness was associated with lower risk of concurrent IADL/ADL, but unrelated to incident limitations. Physical activity, disease burden, depressive symptoms, self-rated health, handgrip strength, falls, and smoking status mediated the relation between personality traits and incident IADL/ADL limitations. The present study indicates that personality traits are risk factors for both IADL and ADL limitations across multiple national cohorts, identifies potential mediators, and informs conceptual models on psychological risk factors for functional decline.

Keywords: Big Five, functional limitations, longitudinal, meta-analysis, mediation analysis

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Activities of daily living (ADLs) are fundamental skills typically needed to manage basic physical needs, such as eating, toileting, or personal hygiene. Instrumental ADLs (IADLs), which are generally categorized separately from ADLs, include more complex activities related to independent living in the community, such as managing money, doing laundry, or taking medications. Limitations in IADLs and ADLs are commonly used as indicators of disability and functional impairment among older individuals (e.g., Greysen et al., 2015, 2017). These functional limitations are associated with poorer quality of life (Gobbens, 2018; Gureje et al., 2006) and increased health care utilization and related costs (Johnston et al., 2018). IADL/ADL disability is also associated with accelerated cognitive decline (Rajan et al., 2013) and mortality (Stineman et al., 2012). Given their impact on health and well-being, research on factors associated with increased risk of functional limitations can help identify groups at higher risk and suggest potential targets of interventions. Several factors may increase the likelihood of developing IADL/ADL limitations in old age, such as chronic disease, cognitive performance, physical activity, education, or depressive symptoms (den Ouden et al., 2013). The present study focused specifically on the association between psychological dispositions, namely, personality traits, and IADL/ADL limitations.

Prior studies have found that personality traits described by the Five Factor Model (FFM: Digman, 1990) are associated with self-report IADLs and ADLs in old age (Chapman et al., 2007; Krueger et al., 2006; Suchy et al., 2010). In cross-sectional studies, lower conscientiousness (the tendency to be disorganized and lower self-disciplined) and higher neuroticism (the tendency to experience distress and anxiety) have been associated consistently with IADL and ADL limitations (e.g., Chapman et al., 2007; Jang et al., 2003; Kempen, van Heuvelen, et al., 1999; Suchy et al., 2010). In contrast, there is less evidence for openness (the tendency to be curious and to entertain new ideas), agreeableness (the tendency to be trusting and cooperative), and extraversion (the tendency to experience positive emotions and to be outgoing; Chapman et al., 2007; Krueger et al., 2006). The evidence from the few longitudinal studies is mixed. For example, one study found that higher neuroticism and lower conscientiousness and extraversion are related to the risk of incident ADL limitations (Krueger et al., 2006; $N = 813$, follow-up = ~6 years), whereas another found no relation (Kempen, Sonderen, et al., 1999; $N = 753$, follow-up = 2 years). In addition, Wettstein et al. (2018) found that lower agreeableness and higher neuroticism predict limitations in ADL 4 years later, but only for older adults who have sensory impairment ($N = 168$, follow-up = 4 years). However, a recent meta-analysis of >130,000 participants found that lower conscientiousness and higher neuroticism are associated with a reduction of ADL limitations-free life years (average follow-up = 7.2 years; Jokela et al., 2020).

As noted by Allemand and Hill (2020), many prior studies underline the theoretical importance of understanding how personality is associated with consequential aging outcomes (Freund et al., 2019; Hill & Roberts, 2016). These developmental studies have consistently supported the argument that personality traits may act as one causal root of many pathways implicated in health outcomes. For example, through their *Life Course Risk Chain Model*, Chapman et al. (2014) provide a conceptual model in which detrimental personality traits generate social and behavioral outcomes that progress from biological health problems to death. This model argues that these consequential aging outcomes are the result of numerous "multifaceted" mechanisms. Empirical studies in this field, however, mainly provide simplistic explanations (Allemand & Hill, 2020), such as a focus on a single behavioral mechanism as an explanation for the effect of personality traits on health outcomes in late life. Thus, in addition to the association between personality traits and functional limitations, the present study aims to identify potential mechanisms underlying these associations.

Personality traits are associated consistently with a range of behavioral factors, such as physical inactivity and smoking (Hakulinen, Hintsanen, et al., 2015; Sutin et al., 2016), which contribute to the incidence of IADL/ADL impairments in old age (Balzi et al., 2010; den Ouden et al., 2013). In addition, a psychological pathway may also explain the relation between personality traits and IADL/ADL limitations. For example, personality traits are associated with depressive symptoms (Hakulinen, Elovainio, et al., 2015), a determinant of IADL/ADL limitations in old age (Nakamura et al., 2017). Similarly, physical mechanisms may also partially explain how personality traits are associated with functional limitations in late life. Prior studies showed that personality traits are related to physical parameters related to IADL/ADL limitations (Sekaran et al., 2013; Wang et al., 2020), such as falling and handgrip strength (Canada et al., 2020; Tolea et al., 2012). Finally, personality traits are related to several health-related outcomes among older people, such as self-rated health or chronic disease (Stephan et al., 2020; Sutin et al., 2013), which are associated with an increased risk of developing IADL/ADL limitations (den Ouden et al., 2013; Fong & Kok, 2020). Previous studies have not addressed whether these factors could explain the relation between traits and functional limitations. To fill this gap, the present study examined whether the relations between personality traits and functional limitations were accounted for these medical, physical, psychological, and behavioral pathways.

To date, prior studies have examined only one of the dimensions of functional limitations (either IADL or ADL, e.g., Suchy et al., 2010; Wettstein et al., 2018) or a composite score of both (IADL and ADL, e.g., Jang et al., 2003; Kempen, van Heuvelen, et al., 1999). These approaches do not provide a clear test of whether the links between personality and functional limitations are similar across IADLs and ADLs. For example, IADLs involve a broader range of more complex activities compared to ADLs, and personality traits are likely to have stronger associations with such broader activities that tap multiple domains of functioning. In addition, these results do not indicate whether the associations of personality with IADLs and ADLs are independent, or whether the potential effects of personality on IADLs are explained by the effects of personality on ADLs. Beyond this conceptual interest, there are also clinical reasons to investigate the relation separately between personality traits, IADLs, and ADLs. Previous studies, for example, have demonstrated that the developmental implications of ADLs or IADLs may be different, notably that ADLs are the most severe and least common form of functional disability and generally occur later (Gobbens & van der Ploeg, 2020; Hennessy et al., 2015; Na et al., 2017).

Based on multiple large-scale cohort studies, the present research sought to advance the literature by examining both cross-sectional and prospective associations between personality traits and both IADL and ADL limitations and identify potential mechanisms linking personality to functional limitations. The use of multiple

cohort samples in a pooled analysis allows for more robust and replicable results (Hofer & Piccinin, 2009; Weston et al., 2020) because the associations are tested across samples that differ in age, nationality, and measures of IADLs/ADLs and personality. Eight samples were identified that were comparable in overall design, with personality traits and IADLs/ADLs assessed at baseline, and IADLs/ADLs assessed again years later. Based upon the pooled analysis approach, the association between personality traits and IADL/ADL limitations was estimated separately within each sample and then summarized using meta-analytic techniques. Consistent with findings from prior studies (Chapman et al., 2007; Jokela et al., 2020; Krueger et al., 2006), it was hypothesized that higher neuroticism and lower conscientiousness would be associated with concurrent and incident IADL and ADL limitations. In addition, we also had a more tentative hypothesis that lower extraversion and lower openness would be associated with IADL and ADL limitations. We expected the associations to be stronger for IADL compared to ADL and explored whether the associations of personality with ADL and IADL were independent. To further inform personality and developmental theoretical frameworks, this study further tested hypotheses based on the conceptual model shown in Figure 1. Specifically, to examine probable mechanistic pathways, the study tested multiple potential mediators to advance knowledge on medical, physical, psychological, and behavioral pathways that link personality to the incidence of functional limitations. We focused on potential mediators based on their availability in the study data sets and based on existing evidence of their relation with both personality traits and IADL/ADL limitations in older age (e.g., den Ouden et al., 2013; Fong & Kok, 2020; Wang et al., 2020). Specifically, the study tested to what extent disease burden, falls, handgrip strength, self-rated health, depressive symptoms, physical activity, and smoking were mediators of the association between personality traits and incident IADL/ADL limitations.

Methods

Study Sample

Participants were drawn from eight samples of adults: The English Longitudinal Study of Aging (ELSA), the Health and Retirement Study (HRS), the Midlife in Japan survey (MIDJA), the Midlife in the United States Survey (MIDUS), the National Health and Aging Trends Study (NHATS), the National Social Life, Health, and Aging Project (NSHAP), the Wisconsin Longitudinal Study Graduate (WLSG) and Sibling (WLSS). In each sample, participants were included in the analysis when they had completed data on demographic factors, personality traits, and IADL/ADL data at baseline. WLSG and WLSS were not included in longitudinal analyses because only one wave of IADL/ADL data was available in these samples. Descriptive statistics for the eight samples are shown in Table 1. Attrition analyses are presented in the Supplemental materials.

ELSA is a representative cohort of older adults living in England aged 50 years and older. Baseline personality, demographic, and

Figure 1

Conceptual Framework of Causal Pathways Between Personality Traits and the Incidence of Instrumental Activities of Daily Living (IADLs)/ Activities of Daily Living (ADLs) Limitations

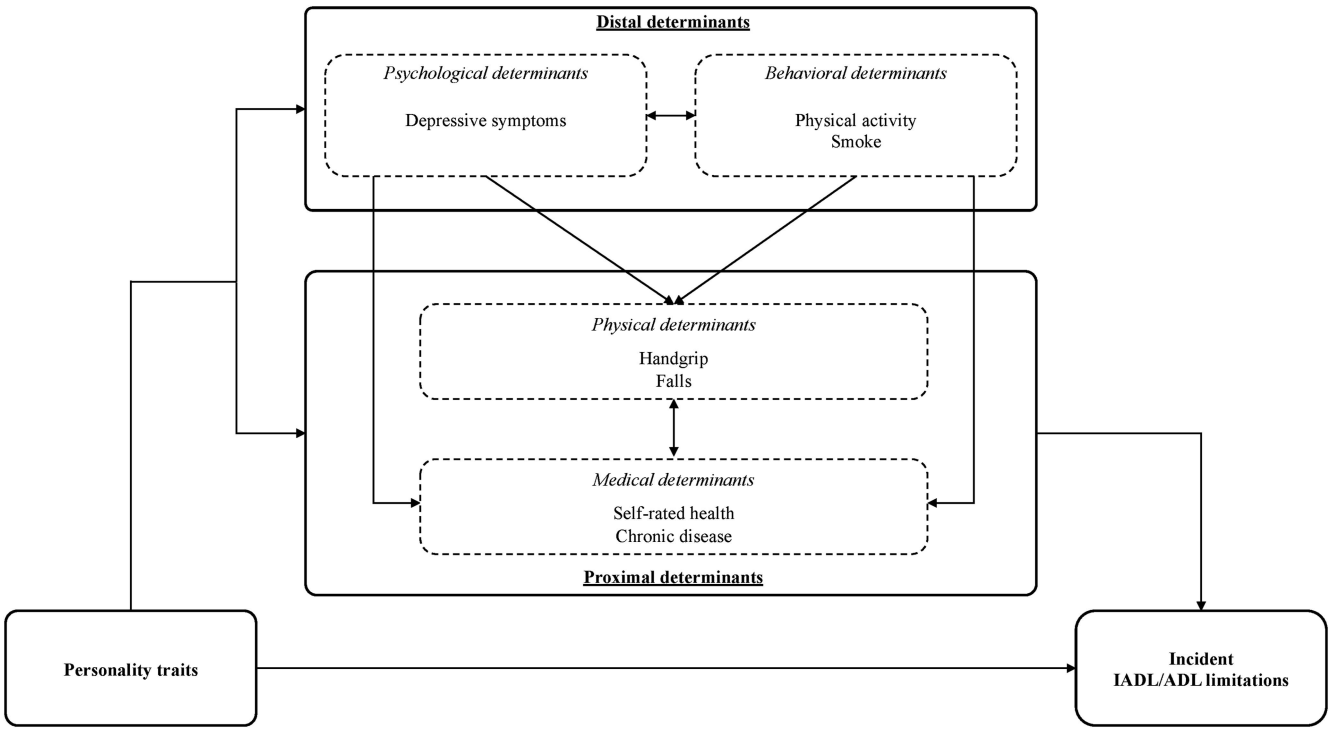

Table 1
Demographic Characteristics of Each Sample at Baseline

Variables	ELSA[a]	HRS[a]	MIDJA[a]	MIDUS[a]	NHATS[a]	NSHAP[a]	WLSG[a]	WLSS[a]
Age (in years)	66.06 (9.48)	68.68 (9.98)	54.15 (14.01)	46.80 (12.90)	77.81 (6.81)	72.23 (6.98)	71.16 (0.90)	68.46 (6.48)
Sex (% women)	55.76	64.03	50.94	52.58	71.81	54.74	53.21	49.39
Race (% White)	97.60	84.93	—	90.49	74.34	84.88	—	—
Education	4.17 (2.23)	12.72 (4.12)	4.49 (2.07)	6.87 (2.47)	5.49 (2.11)	2.83 (0.98)	14.00 (2.43)	14.31 (2.58)
Neuroticism	2.10 (0.59)	2.12 (0.62)	2.10 (0.55)	2.23 (0.66)	2.20 (0.84)	1.14 (0.58)	2.98 (0.91)	2.99 (0.90)
Extraversion	3.14 (0.55)	3.14 (0.56)	2.43 (0.67)	3.19 (0.56)	3.24 (0.70)	2.20 (0.55)	3.78 (0.87)	3.76 (0.89)
Openness	2.88 (0.55)	2.90 (0.54)	2.18 (0.60)	3.01 (0.52)	2.86 (0.80)	1.92 (0.65)	3.49 (0.74)	3.50 (0.73)
Agreeableness	3.50 (0.49)	3.54 (0.46)	2.63 (0.63)	3.48 (0.48)	3.61 (0.49)	2.45 (0.51)	4.80 (0.70)	4.79 (0.69)
Conscientiousness	3.29 (0.49)	3.31 (0.47)	2.68 (0.54)	3.42 (0.44)	3.32 (0.66)	2.36 (0.54)	4.77 (0.70)	4.75 (0.69)
Baseline IADL limitations[b]	17.35%	12.89%	27.64%	39.39%	19.36%	25.37%	16.34%	14.99%
Incident IADL limitations at follow-up[c]	9.96%	8.65%	10.19%	44.30%	8.88%	15.37%	—	—
Baseline ADL limitations[d]	16.15%	30.06%	16.25%	13.79%	20.81%	31.74%	9.08%	9.32%
Incident ADL limitations at follow-up[e]	8.06%	16.63%	7.73%	11.76%	11.53%	18.80%	—	—

Note. Numbers are mean values (standard deviations) or percentages.
ELSA = The English Longitudinal Study of Aging; HRS = the Health and Retirement Study; MIDJA = Midlife in Japan survey; MIDUS = the Midlife in the United States Survey; NHATS = the National Health and Aging Trends Study; NSHAP = the National Social Life, Health, and Aging Project; WLSG/WLSS = the Wisconsin Longitudinal Study Graduate/Sibling. Follow-up: HRS = 8 years; ELSA = 6 years; MIDUS = 18 years; MIDJA = 4 years; NHATS = 3 years; NSHAP = 5 years.
[a] Sample size for participant with IADL and ADL data available: ELSA: $N = 8{,}315$; HRS: $N = 4{,}732$; MIDJA: $N = 1{,}002$; MIDUS: $N = 6{,}174$; NHATS: $N = 1{,}029$; NSHAP = 1,938; WLSG: $N = 3{,}619$; WLSS: $N = 1{,}925$.
[b] Sample size for participant with IADL data available at baseline: ELSA: $N = 8{,}315$; HRS: $N = 10{,}223$; MIDJA: $N = 1{,}002$; MIDUS: $N = 6{,}174$; NHATS: $N = 1{,}033$; NSHAP: $N = 1{,}943$; WLSG: $N = 3{,}622$; WLSS: $N = 1{,}927$.
[c] Sample size for participant with incident IADL data available at follow-up: ELSA: $N = 5{,}132$; HRS: $N = 5{,}784$; MIDJA: $N = 477$; MIDUS: $N = 1{,}702$; NHATS: $N = 501$; NSHAP: $N = 1{,}080$.
[d] Sample size for participant with ADL data available at baseline: ELSA: $N = 8{,}315$; HRS: $N = 6{,}499$; MIDJA: $N = 1{,}003$; MIDUS: $N = 6{,}174$; NHATS: $N = 2{,}541$; NSHAP: $N = 2{,}057$; WLSG: $N = 3{,}885$; WLSS: $N = 2{,}092$.
[e] Sample size for participant with incident ADL data available at follow-up: ELSA: $N = 5{,}167$; HRS: $N = 2{,}287$; MIDJA: $N = 563$; MIDUS: $N = 2{,}401$; NHATS: $N = 1{,}433$; NSHAP: $N = 1{,}117$.

IADL/ADL data were obtained from 8,135 individuals in 2010–2011 (Wave 5). Of these participants, 5,132 also provided data on IADLs and 5,167 on ADLs at follow-up in 2016–2017 (Wave 8).

HRS is a national longitudinal study of U.S. adults older than 50 years. Personality traits, demographic factors, and IADL/ADL data were obtained at baseline for half of the sample in 2006 and from the other half in 2008. Data from both waves were combined, resulting in a sample of 10,223 participants for IADLs and 6,499 participants for ADLs. Follow-up IADL/ADL data were assessed from the 2014 wave for participants in the 2006 sample and from the 2016 wave for participants in the 2008 wave. A total of 5,784 and 2,287 individuals provided follow-up IADL and ADL data, respectively.

MIDUS is a longitudinal study of U.S. adults aged 20–75 years. Personality traits, demographic factors, and IADL/ADL were assessed at baseline from the first wave (1995–1996). Complete data were obtained from 6,174 participants at baseline for IADLs and 6,174 for ADLs. Follow-up IADL/ADL data were obtained at the third wave (2013–2014). Of the total baseline sample, 1,702 participants had complete IADL data at follow-up and 2,401 for ADL data.

MIDJA is a parallel survey of the MIDUS. The MIDJA study is a probability sample of Japanese adults aged 30–79 from the Tokyo metropolitan area. The present study used data from the first (2008) and second (2012) waves. Complete data were obtained from 1,002 participants at baseline for IADLs and 1,003 for ADLs. Of these participants, 304 and 563 also provided data on IADLs and ADLs at follow-up, respectively.

NHATS is a prospective cohort study of Medicare enrollees aged 65 years and older. Personality was first assessed in 2013 for one third of the sample and in 2014 for the second third. Data from both waves were combined, resulting in a sample of 1,033 participants for IADLs and 2,541 for ADLs. Follow-up IADL/ADL data were obtained in 2016 (for participants of the 2013 wave) and 2017 (for participants of the 2014 wave). Of the total baseline sample, 501 individuals had IADL data at follow-up and 1,433 had ADL data.

NSHAP is a longitudinal study of health and social factors of U.S. older adults aged 57–85 years. Personality traits, demographic factors, and IADL/ADL were assessed at Wave 2 (2010–2011). Complete data were obtained from 1,943 participants at baseline for IADLs and 2,057 for ADLs. Of these participants, 1,080 and 1,117 also provided data for IADLs and ADLs at follow-up in 2015–2016 (Wave 3), respectively.

WLS was initiated with a random sample of individuals who graduated from a Wisconsin high school in 1957 (WLSG). In addition to this target sample of graduates, the WLS also collected data on a selected sibling of some of the graduates (WLSS). For WLSG and WLSS, personality, demographic, and IADL/ADL data were obtained in 2010–2011, the only wave that included a measure of IADL/ADL. In the WLSG, a total of 3,622 participants provided complete baseline data for IADLs and 3,885 for ADLs. In the

WLSS, baseline data were obtained from 1,927 individuals for IADLs and 2,092 for ADLs.

Measures

Personality

In ELSA, HRS, MIDJA, MIDUS, NHATS, and NSHAP, personality traits were assessed using the Midlife Development Inventory (MIDI; Zimprich et al., 2012). A 26-item version was used in the HRS and ELSA, a 25-item version in MIDUS and MIDJA, a 21-item version in the NHSAP, and a 10-item version in the NHATS. Participants were asked to indicate how much each adjective that assessed neuroticism (e.g., moody), openness (e.g., curious), extraversion (e.g., outgoing), conscientiousness (e.g., organized), and agreeableness (e.g., warm) described them on a scale ranging from 1 (*not at all*) to 4 (*a lot*). In the WLSG and the WLSS, a 29-item version of the Big Five Inventory (John et al., 1991) was used. A 6-point scale, ranging from 1 (*disagree strongly*) to 6 (*agree strongly*), was used to assess agreement or disagreement with descriptive statements assessing the five personality traits.

IADL/ADL

Based on the Lawton IADLs Scale (Lawton & Brody, 1969), IADL limitations included difficulty in one or more of the following activities: (a) groceries shopping, (b) preparing (hot) meal, (c) managing money, (d) making phone calls, (e) taking medication, (f) using map, (g) doing housework, and (h) doing laundry. In MIDUS and MIDJA, IADLs also included the following: (i) climbing several flights of stairs, and (j) doing moderate activities (e.g., bowling or vacuuming) activities. According to the Katz index (Katz et al., 1963), ADL limitations are defined as having difficulty to perform one or more of the following activities: (a) dressing, (b) bathing, (c) eating, (d) using toilet, (e) getting in/out of bed, (f) walking in a room, and (g) walking one block. Details of activities assessed in each ample are presented in the Supplementary material (Table S1). In MIDUS, MIDJA, and NHATS, participants were asked to report their difficulty doing IADLs or ADLs on a scale from 1 (*not at all*) to 4 (*a lot*). Participants rated their difficulties on a scale from 0 (*no difficulty*) to 4 (*unable to do*) in the NSHAP. In ELSA, HRS, WLSG, and WLSS respondents reported any difficulties (yes/no) with IADLs or ADLs. Those who performed all activities without any difficulty were classified as free from limitations. Participants were categorized as having IADL or ADL limitations when they reported difficulty in performing at least one IADL or ADL. Participants were considered to have incident IADL or ADL limitations if they were free of IADL or ADL limitations at baseline but reported IADL or ADL limitations at follow-up. As suggested by several studies (LaPlante, 2010; Spector & Fleishman, 1998), a composite score of IADLs and ADLs was used in supplementary analyses to represent a single underlying dimension of functional limitations.

Mediators

In samples with available IADL/ADL longitudinal data (the WLS samples were not examined because they did not include a follow-up IADL/ADL assessment), the following mediators were considered.

Physical Activity

In HRS and ELSA, participants were asked to indicate how often they participated in moderate and vigorous physical activity on a scale from 1 (*hardly ever or never*) to 4 (*more than once a week*). In the NSHAP, participants were asked how often they participate in physical activity such as walking, dancing, gardening, physical exercise or sports on a scale from 0 (*never*) to 4 (*3 or more time per week*). In the MIDUS, participants reported how frequently they participated in moderate leisure (e.g., *slow or light swimming or brisk walking*) and vigorous physical activity (e.g., *running or lifting heavy objects*) during both the summer and the winter months on a scale ranging from 1 (*several times per week or more*) to 6 (*never*). The composite score was reversed so that higher scores indicated greater overall physical activity. In the MIDJA, participants reported how frequently they followed exercise therapies such as yoga or thaï chi in the past 12 months on a scale from 1 (*never*) to 5 (*a lot*). In the NHATS, participants were asked to report whether they ever spent time on vigorous activities in the last month (e.g., *working out, swimming, running or biking, or playing a sport*) using a yes/no format.

Depressive Symptoms

The 11-item version from the Iowa Short Form of the Center for Epidemiologic Studies Depression Scale (CES-D; Kohout et al., 1993) was used to measure depressive symptoms in the NSHAP. A shorter eight-item version of the CES-D (Wallace et al., 2000) was used in the HRS and in the ELSA. For the 8- or 11-item versions of the CES-D, participants indicated whether they experienced several symptoms during the past week using a yes/no format. The Composite International Diagnostic Interview Short Form (CIDI–SF; Kessler et al., 1998) was used in the MIDUS. Participants reported their experience of depressed mood and anhedonia that lasted for 2 weeks in the last 12 months using a yes/no format. In the NSHAP, HRS, ELSA, and the MIDUS, answers were summed across items, with higher scores representing more depressive symptoms. Depressive symptoms were assessed in the NHATS using the two-item version of Patient Health Questionnaire (PHQ-2; Kroenke et al., 2003). Participants reported how frequently they have been bothered by "*little interest or pleasure in doing things*" and by "*feeling down, depressed, or hopeless*" over the past 2 weeks, using a scale ranging from 0 (*not at all*) to 3 (*nearly everyday*). The mean of the two items was computed. In the MIDJA, participants answered an item that asked them to rate whether they experienced anxiety or depression in the last year, using a yes/no format.

Disease Burden

In the six samples, disease burden was the sum of the following diagnosed conditions: stroke, diabetes, lung disease, cancer (except in the MIDJA), arthritis, osteoporosis (except in the HRS and NSHAP), heart conditions (except in the ELSA), high blood pressure (except in the ELSA), asthma for ELSA and NSHAP, ulcers for NSHAP, and Parkinson's disease for ELSA.

Self-Rated Health

A single-item measure was used in the ELSA, HRS, NHATS, and NSHAP: "*Would you say your health is excellent, very good, good,*

fair, or poor?." In the MIDUS and the MIDJA, participants were asked how they would rate their health these days on a scale ranging from 0 (*the worst possible health*) to 10 (*the best possible health*). Across all samples, this item was scored such that higher scores indicated better self-rated health.

Grip Strength

Handgrip strength was tested as mediator in the HRS and NHATS only. It was measured in kilograms using a dynamometer. The highest measurement from two trials on each hand in the HRS and for the dominant hand in the NHATS was used in the analyses.

Falls

Fall was included as mediator in the ELSA, HRS, NHATS, and NSHAP. In ELSA, NHATS, and NSHAP, participants rated whether they had fallen in the past 12 months, using yes/no format. In the HRS, participants were asked whether they had fallen down in the last 2 years. In each sample, the response was categorized as yes (coded as 1) or no (coded as 0).

Smoking

In each sample, current smoking was coded as 1 and former/never smokers were coded as 0.

Covariates

In each sample, age, sex, and education were included as covariates. Education was reported in years in the HRS, WLSG, and WLSS and was measured on a scale ranging from 1 (*No qualification*) to 7 (*NVQ4/NVQ5/Degree or equivalent*) in ELSA, from 1 (*no grade school*) to 12 (*doctoral level degree*) in the MIDUS, from 1 (*8th grade high school*) to 8 (*graduate school*) in the MIDJA, from 1 (*No schooling completed*) to 9 (*Master's, professional, or doctoral degree*) in the NHATS, and from 1 (*high school*) to 4 (*bachelor's degree or higher*) in NSHAP. Race was controlled for in the ELSA, HRS, MIDUS, NHATS, and NSHAP and coded as White versus other.

Statistical Analysis

Logistic regression analysis was conducted to test whether personality traits were related to IADL/ADL limitations. In a first set of analyses, baseline IADL or ADL limitations were regressed on baseline personality, controlling for age, sex, education, and race (in all samples except the WLSG, WLSS, and MIDJA). In each sample, except for the WLSG and WLSS, a second set of analyses tested if baseline personality predicted incident IADL or ADL limitations for participants who did not report any IADL/ADL limitations at baseline, controlling for baseline covariates. A random-effects meta-analysis using the Comprehensive Meta-Analysis software combined the estimates from all samples. Personality traits were standardized, and separate analyses were conducted for each trait. Supplementary analyses were conducted with the five traits entered simultaneously to evaluate whether the prospective association of each trait with IADL/ADL limitations was independent of the other traits.

Mediation analyses were conducted for the association between personality traits and incident IADL/ADL limitations to identify potential pathways between personality traits and the incidence of functional limitations. Precisely, disease burden, falls, handgrip strength, self-rated health, depressive symptoms, physical activity, and smoking at baseline were tested as mediators using Mplus software with 5,000 bootstrapped samples (Hayes, 2013). To determine whether the full set of variables together explain the relation between personality traits and IADL/ADL limitations, these mediators were included simultaneously in the analysis. Separate analyses were conducted for each trait.

A set of sensitivity analyses was conducted to better understand the association between personality traits and the incidence of IADL/ADL over time. First, to test whether the relation between personality and IADLs is independent of the association between personality on ADL, we tested whether personality traits predict IADL limitations once the incidence of ADL limitations was taken into account. Second, similar to some previous studies, we tested the prospective associations between personality traits and a composite score of IADLs and ADLs to evaluate the association with a single underlying dimension of functional limitations.

Results

Descriptive statistics for each sample are shown in Table 1.

Concurrent Associations

At baseline, higher neuroticism was related to higher risk of IADL and ADL limitations, whereas higher conscientiousness was associated with lower risk of IADL and ADL limitations (Tables S2 and S3). These associations were significant in each of the eight samples, and the overall pattern of associations was supported by the meta-analysis. Specifically, one standard deviation (*SD*) higher in neuroticism was related to 45% and 37% higher risk of IADL and ADL limitations, respectively (Tables S2 and S3). Every *SD* higher in conscientiousness was associated with 47% and 38% lower risk of concurrent IADL and ADL limitations, respectively. Extraversion, openness, and agreeableness were also associated negatively with IADL or ADL limitations at baseline. Specifically, every *SD* higher extraversion, openness, and agreeableness were related to about 35%, 13%, and 14% lower odds of IADL limitations, respectively, (Table S2) and to 35%, 11%, and 11% lower odds of ADL limitations, respectively (Table S3).

Prospective Associations

As hypothesized, higher neuroticism at baseline was related consistently to a higher risk of incident IADL and ADL limitations over time (Tables 2 and 3). These associations were significant in three of the six samples, and the overall pattern of associations was supported by the meta-analysis. Specifically, one *SD* higher in neuroticism was related to 27% and 20% higher risk of IADL and ADL limitations, respectively (Tables 2 and 3). In addition, higher conscientiousness was related to lower risk of IADL and ADL limitations over time (Tables 4 and 5). Theses associations were significant in five of the six samples for IADLs and three of the six samples for ADLs, and the overall pattern was supported by the

Table 2

Summary of Logistic Regression Analysis Predicting Incident IADL Limitations at Follow-Up From Baseline Personality Traits (IADLs = Instrumental Activities of Daily Living)

Sample	Neuroticism	Extraversion	Openness	Agreeableness	Conscientiousness
ELSA[a]	1.26***	0.70***	0.80***	0.99	0.78***
	(1.16–1.38)	(0.65–0.76)	(0.74–0.88)	(0.91–1.08)	(0.72–0.85)
HRS[a]	1.34***	0.77***	0.80***	0.93	0.75***
	(1.24–1.45)	(0.71–0.83)	(0.74–0.86)	(0.86–1.01)	(0.69–0.81)
MIDJA[b]	1.17	0.90	1.02	1.09	0.90
	(0.91–1.49)	(0.71–1.15)	(0.80–1.29)	(0.86–1.38)	(0.70–1.14)
MIDUS[a]	1.29***	0.91	0.89*	1.01	0.75***
	(1.16–1.43)	(0.82–1.01)	(0.81–0.99)	(0.91–1.12)	(0.68–0.83)
NHATS[a]	1.17	1.02	0.90	1.31	0.67**
	(0.91–1.50)	(0.80–1.32)	(0.69–1.16)	(0.98–1.75)	(0.53–0.84)
NSHAP[a]	1.11	0.95	0.93	0.95	0.85*
	(0.94–1.29)	(0.81–1.11)	(0.79–1.08)	(0.81–1.12)	(0.73–0.99)
Random effect	1.27***	0.85**	0.85**	0.99	0.77***
	(1.20–1.33)	(0.76–0.95)	(0.80–0.91)	(0.93–1.05)	(0.73–0.81)
Heterogeneity τ^2	0.000	0.015	0.002	0.001	0.001

Note. Coefficients are standardized coefficients.
ELSA = The English Longitudinal Study of Aging; HRS = the Health and Retirement Study; MIDJA = Midlife in Japan survey; MIDUS = the Midlife in the United States Survey; NHATS = the National Health and Aging Trends Study; NSHAP = the National Social Life, Health, and Aging Project. ELSA: N = 5,132; HRS: N = 5,784; MIDJA: N = 477; MIDUS: N = 1,702; NHATS: N = 501; NSHAP: N = 1,080.
[a] Adjusted for age, sex, education, and race.
[b] Adjusted for age, sex, and education.
* $p < .05$. ** $p < .01$. *** $p < .001$.

meta-analysis. For every *SD* higher conscientiousness, the likelihood of incident IADL and ADL limitations increased by 29% and 26%, respectively (Tables 2 and 3). Moreover, extraversion and openness were also associated negatively with incident ADL and IADL limitations over time. Specifically, every *SD* higher extraversion and openness were related to about 17% lower odds of incident IADL limitations (Table 2), and, respectively, related to about 9% and 6% lower odds of incident ADL limitations (Table 3). Supplementary analyses conducted with the five traits entered simultaneously indicated similar results for neuroticism, conscientiousness, and extraversion (Supplementary Tables S4 and S5). However, the relation between openness to experience and the incidence of IADL/ADL limitations became nonsignificant in every sample. In addition, the association between higher agreeableness and higher

Table 3

Summary of Logistic Regression Analysis Predicting Incident ADL Limitations at Follow-Up From Baseline Personality Traits (ADLs = Activities of Daily Living)

Sample	Neuroticism	Extraversion	Openness	Agreeableness	Conscientiousness
ELSA[a]	1.31***	0.81***	0.91*	1.04	0.88**
	(1.19–1.44)	(0.74–0.89)	(0.83–0.99)	(0.95–1.14)	(0.81–0.9)
HRS[a]	1.07	0.95	0.95	1.01	0.92
	(0.98–1.17)	(0.87–1.04)	(0.89–1.04)	(0.92–1.10)	(0.84–1.00)
MIDJA[b]	107	0.96	0.94	1.24	0.77
	(0.79–1.44)	(0.72–1.27)	(0.70–1.25)	(0.94–1.63)	(0.58–1.03)
MIDUS[a]	1.33***	0.97	0.98	1.05	0.78***
	(1.20–1.47)	(0.88–1.06)	(0.89–1.08)	(0.94–1.16)	(0.71–0.86)
NHATS[a]	1.27***	0.98	1.04	1.00	0.85*
	(1.10–1.47)	(0.85–1.13)	(0.90–1.20)	(0.87–1.16)	(0.74–0.98)
NSHAP[a]	1.09	0.85*	0.85*	0.97	0.88
	(0.95–1.26)	(0.74–0.98)	(0.74–0.98)	(0.84–1.13)	(0.77–1.01)
Random effect	1.20***	0.91*	0.94*	1.03	0.86***
	(1.10–1.32)	(0.85–0.98)	(0.90–0.99)	(0.98–1.08)	(0.81–0.91)
Heterogeneity τ^2	0.008	0.003	0.000	0.000	0.001

Note. Coefficients are standardized coefficients.
ELSA = The English Longitudinal Study of Aging; HRS = the Health and Retirement Study; MIDJA = Midlife in Japan survey; MIDUS = the Midlife in the United States Survey; NHATS = the National Health and Aging Trends Study; NSHAP = the National Social Life, Health, and Aging Project. ELSA: N = 5,167; HRS: N = 2,287; MIDJA: N = 63; MIDUS: N = 2,401; NHATS: N = 1,433; NSHAP: N = 1,117.
[a] Adjusted for age, sex, education, and race.
[b] Adjusted for age, sex, and education.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4

Summary of Random-Effect Meta-Analysis of Mediation Analyses Predicting IADL Incidence From Baseline Personality Traits (IADLs = bInstrumental Activities of Daily Living)

	Neuroticism		Extraversion		Openness		Conscientiousness	
Mediating variables	Estimate (95% CI)	τ^2	Estimate (95% CI)	τ^2	Estimate (95% CI)	τ^2	Estimate (95% CI)	τ^2
Physical activity	0.008*** (0.006; 0.011)	0.000	−0.014** (−0.023; −0.005)	0.000	−0.013*** (−0.017; −0.009)	0.000	−0.013*** (−0.018; −0.009)	0.000
Disease burden	0.015*** (0.010; 0.019)	0.000	−0.004 (−0.011; 0.002)	0.000	−0.006*** (−0.010; −0.003)	0.000	−0.010*** (−0.015; −0.004)	0.000
Depressive symptoms	0.029*** (0.014; 0.045)	0.000	−0.012* (−0.023; −0.001)	0.000	−0.006* (−0.013; −0.000)	0.000	−0.012** (−0.021; −0.002)	0.000
Self-rated health	0.048*** (0.030; 0.067)	0.000	−0.044*** (−0.060; −0.028)	0.000	−0.033*** (−0.046; −0.020)	0.000	−0.047*** (−0.061; −0.034)	0.000
Handgrip strength	0.010*** (0.005; 0.016)	0.000	−0.008** (−0.013; −0.002)	0.000	−0.010*** (−0.016; −0.005)	0.000	−0.001 (−0.005; 0.002)	0.000
Falls	0.003 (−0.000; 0.007)	0.000	−0.001 (−0.004; 0.001)	0.000	0.000 (−0.001; 0.003)	0.000	−0.001 (−0.004; 0.001)	0.000
Smoke	−0.001 (−0.007; 0.004)	0.000	0.001 (−0.008; 0.003)	0.000	0.003 (−0.000;0.006)	0.000	−0.002* (−0.004; −0.000)	0.000

Note. Bootstrap estimates and 95% bias-corrected confidence interval for indirect effects of personality traits on IADL incidence through physical activity, disease burden, depressive symptoms, self-rated health, handgrip strength, falls, and smoke controlling for age, sex, education, and race when available.
* $p < .05$. ** $p < .01$. *** $p < .001$.

risk of incidence IADL/ADL limitations became significant in three of the six samples for IADLs, and in two of the six samples for ADLs.

Mediation Analyses

The bootstrap mediation analyses indicated that the association between neuroticism and the incidence of IADL/ADL limitations was mediated by lower physical activity, higher disease burden, more depressive symptoms, and lower self-rated health (Tables 4 and 5). In addition, lower handgrip strength mediated the association between neuroticism and incident IADL limitations, whereas falls mediated the association of this personality trait and incident ADL limitations (Tables 4 and 5). Moreover, the meta-analysis supported the mediating role of more physical activity, lower disease burden, less depressive symptoms, and better self-rated health in the association between conscientiousness and lower likelihood of incident IADL/ADL limitations over time (Tables 4 and 5). Less smoking further mediated the prospective relation between conscientiousness and lower risk of incident ADL limitations (Table 5). In addition, mediation analysis revealed that more physical activity, fewer depressive symptoms, better self-rated health, and higher handgrip strength mediated the relation between openness and lower likelihood of incident IADL/ADL limitations (Tables 4 and 5). Finally, the meta-analysis of bootstrapped estimates showed that more physical activity and less depressive symptoms mediated the relation between extraversion and the incidence of IADL/ADL over

Table 5

Random-Effect Meta-Analysis of Mediation Analyses Predicting ADL Incidence From Baseline Personality Traits (ADLs = Activities of Daily Living)

	Neuroticism		Extraversion		Openness		Conscientiousness	
Mediating variables	Estimate (95% CI)	τ^2	Estimate (95% CI)	τ^2	Estimate (95% CI)	τ^2	Estimate (95% CI)	τ^2
Physical activity	0.007*** (0.004; 0.010)	0.000	−0.014** (−0.024; −0.004)	0.000	−0.013*** (−0.017; −0.009)	0.000	−0.013*** (−0.017; −0.008)	0.000
Disease burden	0.012*** (0.007; 0.017)	0.000	−0.005 (−0.012; 0.009)	0.000	−0.002*** (−0.006; 0.001)	0.000	−0.010*** (−0.013; −0.006)	0.000
Depressive symptoms	0.036*** (0.018; 0.054)	0.000	−0.013*** (−0.021; −0.005)	0.000	−0.007** (−0.012; −0.001)	0.000	−0.012** (−0.020; −0.004)	0.000
Self-rated health	0.044*** (0.032; 0.055)	0.000	−0.042*** (−0.057; −0.026)	0.000	−0.028*** (−0.037; −0.019)	0.000	−0.042*** (−0.054; −0.029)	0.000
Handgrip strength	0.001 (−0.001; 0.004)	0.000	−0.002 (−0.005; 0.002)	0.000	−0.003*** (−0.008; 0.001)	0.000	−0.000 (−0.002; 0.001)	0.000
Falls	0.009** (0.002; 0.016)	0.000	−0.001 (−0.004; 0.001)	0.000	−0.001 (−0.006; 0.002)	0.000	−0.004 (−0.010; 0.002)	0.000
Smoke	−0.002 (−0.007; 0.002)	0.000	0.001 (−0.002; 0.005)	0.000	0.004 (−0.001; 0.008)	0.000	−0.002 (−0.006; −0.002)	0.000

Note. Bootstrap estimates and 95% bias-corrected confidence interval for indirect effects of personality traits on ADL incidence through physical activity, disease burden, depressive symptoms, self-rated health, handgrip strength, falls, and smoke controlling for age, sex, education, and race when available.
** $p < .01$. *** $p < .001$.

time (Tables 4 and 5). Higher handgrip strength also mediated the effect of this trait on incident IADL limitations (Table 4).

Sensitivity Analyses

The results revealed that the longitudinal relation between personality traits and IADL limitations persisted accounting for incident ADL limitations (Supplementary Table S6). Neuroticism remained associated with an increased risk of IADL limitations in the ELSA, HRS, and MIDUS, whereas conscientiousness reduced risk of IADL limitations in ELSA, HRS, MIDUS, NHATS, and NSHAP. In addition, extraversion remained associated with a decreased risk of IADL limitations in ELSA and HRS. Finally, openness remained associated with a reduction of risk of IADL limitations in ELSA, HRS, and MIDUS (Supplementary Table S6). These results indicated that the association between personality traits and IADL limitations was independent of ADL difficulties.

Finally, as the global pattern of association was similar across IADLs and ADLs, supplementary analyses were conducted with a composite score of overall functional limitations. Higher neuroticism at baseline was related to concurrent and incident IADL/ADL limitations, whereas higher conscientiousness at baseline was associated with lower risk of concurrent and incident IADL/ADL limitations (Supplementary Tables S7 and S8). Specifically, one *SD* higher in neuroticism was related to 41% and 20% higher risk of concurrent and incident IADL/ADL limitations, respectively, whereas every *SD* higher in conscientiousness was associated with 42% and 20% lower risk of concurrent and incident IADL/ADL limitations (Supplementary Tables S7 and S8). In addition, extraversion, openness, and agreeableness were also associated negatively with IADL/ADL limitations at baseline. Specifically, every *SD* higher extraversion, openness, and agreeableness were related to about 33%, 9%, and 13% lower odds of concurrent IADL/ADL limitations, respectively (Supplementary Table S7). Finally, every *SD* higher extraversion and openness decreased the likelihood of incident IADL/ADL limitations by about 14% (Supplementary Table S8). Less consistent evidence was found for agreeableness and the incidence of IADL/ADL limitations.

Discussion

Based on the eight samples of middle-aged and older adults, the present study examined the association between personality traits and IADL and ADL limitations. Results revealed that the overall pattern of association between personality traits and both IADLs and ADLs was relatively similar, and the associations were slightly stronger for IADLs compared to ADLs. Specifically, higher neuroticism was related to higher likelihood of concurrent IADL/ADL limitations, and higher conscientiousness, extraversion, openness to experience, and agreeableness were associated with lower risk, controlling for demographic factors. Although effect sizes were smaller, a similar pattern emerged in longitudinal analyses: Higher neuroticism was associated with higher risk of incident IADL and ADL limitations, whereas higher conscientiousness, extraversion, and openness were associated with lower risk. This study adds to existing knowledge by providing replicable prospective evidence that personality traits are related to concurrent and incident IADL and ADL limitations, and that this relation is not dependent on the specific measures used, length of the follow-up period, and are consistent across samples from three nations.

The present study further identified medical, physical, psychological, and behavioral pathways through which personality traits are related to incident IADL/ADL limitations. To synthesize, Figure 1 shows a conceptual framework that shows hypothesized causal pathways between traits and functional limitations. The results suggest that individuals higher on neuroticism and lower on conscientiousness and openness are more likely to develop IADL and ADL limitations because they have more chronic diseases and lower self-rated health. These findings confirm that higher neuroticism and lower conscientiousness, extraversion, and openness are associated with important medical and physical outcomes (e.g., Fink et al., 2016; Sutin et al., 2013) that impact functional limitations in later life. In addition to health status, the results of mediation analyses suggest that psychological and behavioral factors may be indirect mechanisms that relate personality traits to incident IADL/ADL impairments. For example, depressive symptoms and physical activity mediate the relation between neuroticism, extraversion, openness, and conscientiousness and incident IADL/ADL limitations. Smoking status also mediates the relation between conscientiousness and incident IADL limitations. These results confirm that higher neuroticism, and lower conscientiousness, extraversion, and openness may be associated with psychological and behavioral risk factors for health deterioration.

Although this study is one of the first to identify potential mechanisms of how personality traits impact functional limitations, additional factors may also explain the association between personality traits and IADLs/ADLs. For example, neuroticism is related to psychological factors that have been associated with incident IADL/ADL limitations (Auais et al., 2018; Yang & Wen, 2015), such as psychological resilience (Oshio et al., 2018) and fear of falling (Mann et al., 2006). In addition, other medical pathways may also operate in the relation between these personality traits and IADL/ADL limitations. Indeed, conscientiousness and openness to experience are associated with decreased risk of hearing impairment (Stephan et al., 2019), which is a recognized risk factor for IADL/ADL disability (Mikkola et al., 2015). Conscientiousness and extraversion are also associated with better sleep quality (Sutin et al., 2020), which is associated with lower odds of incident IADL/ADL limitations (Friedman, 2016). Lower conscientiousness as well as higher neuroticism is also related to cognitive decline (Luchetti et al., 2016), which may increase risk for IADLs/ADLs (Jekel et al., 2015). Finally, other functional parameters not considered in this study may also play a role in the relationship between personality traits and IADL/ADL impairments. For example, higher conscientiousness, extraversion, agreeableness, and openness are related to lower frailty in old age (Stephan et al., 2017) that may reduce risk for IADLs/ADLs (Kojima, 2017). Further studies are needed to complete the present results and the in-depth mechanisms that explain the association between personality traits and the onset of functional limitations in later life.

Results of this study also inform existing knowledge on the relation between personality traits and health outcomes in old age. Indeed, ADL/IADL limitations may be an early manifestation in the pathway between personality and a range of cognitive and health consequences. For example, lower conscientiousness and higher neuroticism are associated with increased risk of cognitive impairment and dementia (Chapman et al., 2020; Terracciano et al.,

2017), and IADL/ADL disabilities have been identified as a marker of the earliest stages of dementia in older age (Fieo et al., 2018; Reppermund et al., 2013). It is likely that the risk of cognitive decline and dementia related to lower conscientiousness and higher neuroticism may manifest through IADL/ADL limitations. In addition, higher neuroticism, lower conscientiousness, and lower extraversion, as well as IADL/ADL impairments are associated with increased risk of mortality (Graham et al., 2017; Stineman et al., 2012). Functional limitations may be one mechanism through which these personality traits are related to higher mortality.

Our theoretical model posited that personality traits, measured at one point in time, are associated with incident IADLs and ADLs measured over time. This model is based, in part, on theoretical models of personality and health that specify mediational pathways that explain the predictive power of personality on long-term outcomes (Shanahan et al., 2014). Personality, however, is not static but tends to change in normative ways across adulthood (Terracciano et al., 2005). Such changes in personality may be one additional mechanism that explains this association. Individuals who increase in neuroticism, for example, may be at greater risk of incident IADL/ADL impairment. Personality traits measured at one point in time, however, are known to be strong, consistent predictors of health outcomes, even when a significant amount of personality change may occur between the personality assessment and the outcome. For example, conscientiousness measured in childhood is a consistent predictor of health outcomes in middle adulthood and premature mortality in older adulthood, regardless of the personality change that inevitably happened between childhood and the outcomes (Hampson et al., 2006, 2013; Kern et al., 2014). This literature and the current findings thus indicate that personality traits measured even just once are consistent predictors of important health-related outcomes and support our theoretical model.

The present study has several strengths, which include testing the associations of personality with both IADLs and ADLs, concurrent and longitudinal analyses, follow-up extending up to 18 years, and the inclusion of eight large samples from different countries. Compiling multiple data sets helps improve generalizability and overall robustness of findings and increases replicability in research (Hofer & Piccinin, 2009; Weston et al., 2020). In line with the study by Jokela et al. (2020), which used this approach to examine the associations between personality traits and incident ADL limitations, the present study adds to existing literature by examining IADL in addition to ADL, and the findings indicate that the associations with IADL limitations are not fully explained by ADLs. Our mediation analyses represent a further major advance compared to previous research. The present results also suggest that these associations may be different according to different cultural backgrounds. For example, although the pattern of results did not differ between the European and American samples, personality traits were not related to the incidence of IADL/ADL limitations in the Japanese sample we examined. Further studies are needed to confirm whether the null finding is due to potential cultural differences, lack of power, or simply a chance finding. In addition, the present study also used a composite score of IADL/ADL limitations in supplementary analysis, which is most suitable for use with adults of all ages and community living (LaPlante, 2010).

However, limitations must be duly noted. For example, the observational design of the present study precludes from any causal interpretations. For example, it has been found that IADL/ADL decline may be associated with personality change (Wettstein et al., 2018). Even if the present study conducted complementary analysis controlling personality traits at follow-up, further studies need to consider employing a more robust two-wave data analysis approach to investigate the bidirectional association between personality traits and IADL/ADL limitations. In addition, the present study focused on the five major personality traits. It would be interesting to deepen the current findings on the relation between personality and IADL/ADL limitations through the examination of underlying facets for each trait. Finally, another limitation is the attrition in the longitudinal data that raises questions on the generalizability of the present findings. The overall similar pattern of associations across the data sets, however, reduces this concern.

Overall, the present study extends existing knowledge by identifying replicable associations between all five personality traits and IADL/ADL limitations. In addition, the current findings indicate that higher conscientiousness, extraversion, and openness are associated with lower risk of concurrent and incident IADL/ADL limitations over time, whereas higher neuroticism increased the odds of concurrent and incident IADL/ADL limitations. This study provides results that inform theoretical model of potential mechanisms that link personality to functional limitations, such as medical (i.e., chronic disease or self-rated health), physical (i.e., handgrip strength or falls), psychological (i.e., depressive symptoms), and behavioral (i.e., physical activity or smoking) pathways. Limitations in (instrumental) ADLs lead to a worse quality of life for older people, accelerated cognitive decline, and an increase health care utilization and related costs (e.g., Gobbens, 2018; Johnston et al., 2018; Rajan et al., 2013). IADL/ADL disabilities are also associated with mortality (Stineman et al., 2012). Identifying factors that have an impact on IADL/ADL limitations is crucial for planning targeted strategies, health care, and promotion activities. The present results suggest that personality traits may be used as an early marker of risk of functional decline in old age. The present study indicates that these associations are robust and replicable across samples that used different measures and from different cultural contexts.

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