Stroke

CLINICAL AND POPULATION SCIENCES

Personality and Risk of Incident Stroke in 6 Prospective Studies

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BACKGROUND: A large literature has examined a broad range of factors associated with increased risk of stroke. Few studies, however, have examined the association between personality and stroke. The present study adopted a systematic approach using a multi-cohort design to examine the associations between 5-Factor Model personality traits (neuroticism, extraversion, openness, agreeableness, and conscientiousness) and incident stroke using data from 6 large longitudinal samples of adults.

METHODS: Participants (age range: 16–104 years old, N=58 105) were from the MIDUS (Midlife in the United States) Study, the HRS (Health and Retirement Study), The US (Understanding Society) study, the WLS (Wisconsin Longitudinal Study), the NHATS (National Health and Aging Trends Study), and the LISS (Longitudinal Internet Studies for the Social Sciences). Personality traits, demographic factors, clinical and behavioral risk factors were assessed at baseline; stroke incidence was tracked over 7 to 20 years follow-up.

RESULTS: Meta-analyses indicated that higher neuroticism was related to a higher risk of incident stroke (hazard ratio, 1.15 [95% CI, 1.10–1.20]; $P<0.001$), whereas higher conscientiousness was protective (HR, 0.89 [95% CI, 0.85–0.93]; $P<0.001$). Additional meta-analyses indicated that BMI, diabetes, blood pressure, physical inactivity, and smoking as additional covariates partially accounted for these associations. Extraversion, openness, and agreeableness were unrelated to stroke incidence.

CONCLUSIONS: Similar to other cardiovascular and neurological conditions, higher neuroticism is a risk factor for stroke incidence, whereas higher conscientiousness is a protective factor.

GRAPHIC ABSTRACT: A graphic abstract is available for this article.

Key Words: adulthood ■ incidence ■ personality ■ risk factor ■ stroke

Stroke is a leading cause of death worldwide[1] and has life-changing consequences, including limitations in activities of daily living,[2] steeper cognitive decline,[3] and higher risk of dementia.[4] A large literature has examined a broad range of demographic, clinical, and behavioral factors associated with increased risk of stroke.[1,5–9] The present study examined whether personality traits are associated with incident stroke.

Personality traits are relatively enduring emotional, cognitive, and behavioral patterns that characterize people over time.[10] Current personality research uses the 5-Factor Model[11] or Big Five to organize and assess personality within 5 broad traits: neuroticism (moody and tense), extraversion (sociable and outgoing), openness (curious and imaginative), agreeableness (cooperative and trusting), and conscientiousness (self-disciplined and responsible). Among these traits, neuroticism and conscientiousness are the most consistently associated with health-related outcomes. Indeed, higher neuroticism and lower conscientiousness are related to higher inflammation,[12] steeper cognitive decline,[13] and higher risk of Alzheimer disease[14] and mortality.[15] Recent research has also found an association between higher neuroticism and higher risk of Parkinson's Disease[16] and vascular dementia.[17] Extraversion, openness, and agreeableness are less consistently associated with health-related outcomes.[12,14]

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Nonstandard Abbreviations and Acronyms

HRS	Health and Retirement Study
LISS	Longitudinal Internet Studies for the Social Sciences
MIDUS	Midlife in the United States Study
NHATS	National Health and Aging Trends Study
US	Understanding Society
WLS	Wisconsin Longitudinal Study

There is indirect evidence for an association between personality and stroke. Higher neuroticism and lower conscientiousness, for example, have been related to higher cardiovascular risk[18,19] and higher risk of heart disease.[20] In addition, higher neuroticism and lower conscientiousness are associated with several leading clinical and behavioral causes of stroke, such as higher BMI,[21] higher risk of diabetes and hypertension,[20] smoking[22] and physical inactivity.[23] Few studies, however, have examined the association between personality and stroke. The evidence has been inconsistent with stroke-related mortality: While no association was found in 1 study,[24] a later and larger study found that higher extraversion and lower conscientiousness were related to a higher risk of stroke-related mortality.[25] But at least 80% of strokes are nonfatal,[26] and only a few studies have examined the association between personality and incident stroke. One study found that lower conscientiousness and lower openness were associated with a higher risk of stroke over 4 years in the Health and Retirement Study[27] Given the differences across outcomes, personality measures, and analytic approaches in the published studies, it is difficult to assess whether there are replicable associations between personality traits and risk of incident stroke. To complement previous research, large multi-cohort research is needed to examine the associations between personality and incident stroke.

The present study examined the associations between FFM personality traits and incident stroke using data from 6 large longitudinal samples of adults. Such coordinated analysis tests the generalizability, replicability, and robustness of an effect across samples that may differ in measurement, follow-up, culture, and age range. Higher neuroticism and lower conscientiousness were expected to relate to higher risk of stroke, given that these traits are consistently associated with risk of cardiovascular disease[20] and leading clinical and behavioral causes of stroke, such as physical inactivity, smoking, obesity, hypertension, and diabetes.[20–23] Given the inconsistency reported in existing research,[25,27] no specific hypothesis was formulated for extraversion, openness, and agreeableness. Further analyses were conducted to test whether clinical (eg, BMI, diabetes, and blood pressure) and behavioral (physical inactivity and smoking) factors accounted for the association between personality and incident stroke in each sample.

METHODS

Participants

The present study reports against STROBE guidelines. It used publicly available de-identified data and was exempt from institutional review board review. Links to data and studies materials are provided below for each sample; data can be obtained directly from each parent study. Written informed consent was obtained from participants in each sample. Participants were included if they had complete data on personality and covariates at baseline and reported on stroke at baseline and on at least 1 follow-up assessment. In each sample, individuals with stroke at baseline were excluded for the main analysis because the focus was on incident stroke. Descriptive statistics for the 6 samples are in Table 1.

The MIDUS (Midlife in the United States) survey is a longitudinal study of noninstitutionalized US adults. The follow-up ranged from January 1995 to June 2014. At baseline, 6093 individuals had complete data on personality, demographic factors, and stroke diagnosis. Stroke diagnosis at follow-up was obtained in 2004-2006 and 2013-2014 from 3977 participants. The final sample had 3960 participants aged 20 to 75 years (55% women; Mean Age=47.22; SD=12.37). MIDUS data is available at http://midus.wisc.edu/index.php.

The HRS (Health and Retirement Study) is a nationally representative longitudinal study of Americans 50 years and older and their spouse. Baseline data on personality traits, demographic factors, and information on stroke diagnosis were obtained in 2006 and 2008 resulting in a baseline sample composed of 12650 participants. Data on stroke were collected every 2 years, with follow-up ranging from March 2006 to May 2021. From the baseline sample, 11741 participants had information on stroke diagnosis at follow-up. The final sample had 11015 individuals aged 50 to 104 years (59% women; mean age=67.78; SD=9.54). HRS data is available at https://hrs.isr.umich.edu/data-products.

The US (Understanding Society) study is a large, nationally representative household panel study. A total of 32968 participants provided personality, demographic factors, and stroke diagnosis in Wave 3 (2011–2012). Stroke diagnosis was assessed every year up to Wave 11, with follow-up ranging from January 2011 to May 2021. Of the baseline sample, 27476 participants had information on stroke diagnosis at follow-up. The final sample had 27066 participants aged 16 to 99 (57% women, mean age=46.35, SD=17.35). US data are available at: https://www.understandingsociety.ac.uk/documentation/access-data.

The Wisconsin Longitudinal Study is a longitudinal study of a random sample of 10317 men and women who graduated from Wisconsin high schools in 1957 and their selected siblings. Personality and demographic factors were obtained in 1992 to 1994 from a total of 10072 participants. Follow-up stroke diagnosis was collected in 2003 to 2007 and 2011. The follow-up period ranged from July 1992 to February 2013. Of the baseline sample, a total of 8904 participants had information on stroke at follow-up. The final sample had 8823 participants aged 29 to 75 years (54% women, mean age=53.12, SD=0.91). WLS

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Table 1. Descriptive Statistics for the 6 Samples

	MIDUS		HRS		US		WLS		NHATS		LISS	
Variables	M/%	SD	M/%	SD	M/%	SD	M/%	SD	M/%	SD	M/%	SD
Age (y)	47.22	12.37	67.78	9.54	46.35	17.35	53.12	0.91	78.93	7.29	45.85	15.75
Sex (% women)	55%	…	59%	…	57%	…	54%	…	59%	…	55%	…
Race (% African American/Black)	4%	…	11%	…	14%*	…	0%	…	20%	…	…	…
Ethnicity (% Hispanic)	…	…	7%	…	…	…	0%	…	5%	…	…	…
Education	7.12	2.46	12.90	2.92	7.34	6.16	13.81	2.40	5.27	2.29	3.43	1.51
Neuroticism	2.22	0.66	2.04	0.61	3.56	1.44	3.21	0.97	2.21	0.85	2.58	0.67
Extraversion	3.19	0.56	3.21	0.55	4.60	1.30	3.82	0.90	3.15	0.75	3.29	0.63
Openness	3.01	0.51	2.96	0.55	4.58	1.30	3.64	0.79	2.83	0.83	3.52	0.50
Agreeableness	3.48	0.49	3.54	0.47	5.64	1.04	4.74	0.74	3.58	0.54	3.91	0.49
Conscientiousness	3.45	0.43	3.38	0.47	5.48	1.10	4.84	0.69	3.22	0.73	3.73	0.52
Incident Stroke (%)	2%		10%		1%		5%		10%		2%	

MIDUS: N=3960; HRS: N=11 015; US: N=27 066; WLS: N=8823; NHATS: N=2319, LISS: N=4922. HRS indicates Health and Retirement Study; LISS, Longitudinal Internet Studies for the Social Sciences; MIDUS, Midlife in the United States Study; NHATS, National Health and Aging Trends Study; US, Understanding Society; and WLS, Wisconsin Longitudinal Study.

*Percent of non-White participants.

(Wisconsin Longitudinal Study) data are available at https://www.ssc.wisc.edu/wlsresearch/data/downloads/.

The NHATS (National Health and Aging Trends Study) is a nationally representative survey of Medicare enrollees aged 65 years and older. Baseline data on personality, demographic factors, and stroke diagnosis were obtained in 2013 and 2014 from 2764 participants. Data on stroke diagnosis were obtained every year up to 2021. The follow-up period ranged from June 2013 to November 2021. Of the baseline sample, 2389 individuals had data on stroke diagnosis at follow-up. The final sample had 2319 participants aged 67 to 101 years (59% women, mean age=78.93, SD=7.29). NHATS data are available at: http://www.nhats.org.

The LISS (Longitudinal Internet Studies for the Social Sciences) is a representative longitudinal sample of the Dutch population. Data on personality, demographic factors, and stroke were obtained in 2007 from 5794 participants. Data on stroke diagnosis were collected every year up to 2021 from 4964 participants within the baseline sample. The follow-up period ranged from November 2007 to December 2021. The final sample had 4922 participants aged 16 to 94 years (55% women, mean age=45.85, SD=15.75). More information about the LISS panel can be found at: www.lissdata.nl.

Measures

Personality

The 5 personality traits were assessed using the Midlife Development Inventory[28] in the HRS, MIDUS, and NHATS. A 26-item version was used in the HRS, a 25-item version was used in the MIDUS, and a 10-item version was used in the NHATS. Participants rated how well adjectives representing the 5 traits described themselves. Example items are worrying (neuroticism), talkative (extraversion), imaginative (openness), warm (agreeableness), and organized (conscientiousness). Answers were given on a scale from 1 (not at all) to 4 (a lot). The Big Five Inventory[29] was used in the WLS and the US. A 29-item version was used in the WLS and a 15-item version was used in the US. Participants rated descriptive statements about the extent to which they see themselves as someone: who worries a lot? (neuroticism), who is talkative? (extraversion), who has an active imagination? (openness), who is considerate to almost everyone? (agreeableness) and who does things efficiently? (conscientiousness). Answers were given on a 6-point scale from 1 (*disagree strongly*) to 6 (*agree strongly*) in the WLS and from 1 (*does not apply to me at all*) to 7 (*applies to me perfectly*) in the US. The LISS used the International Personality Item Pool.[30] Participants rated how accurately 50 items describe themselves. Example items are: get stressed out easily (neuroticism), talk to a lot of different people at parties (extraversion), have a vivid imagination (openness), am interested in people (agreeableness), and like order (conscientiousness). A scale from 1 (very inaccurate) to 5 (very accurate) was used to rate answers. A large item response theory study found that FFM inventories were largely measurement invariant, with very high correlations (>0.90) between estimated latent item response theory scores and sum scores.[31] Cronbach alphas for neuroticism, extraversion, openness, agreeableness, and conscientiousness ranged respectively from 0.70 to 0.88, 0.61 to 0.86, 0.60 to 0.79, 0.57 to 0.81, and 0.54 to 0.77 to across samples. Personality traits were *z*-scored in each sample to facilitate interpretation.

Stroke Diagnosis

In the HRS, WLS, and US, participants were asked to indicate whether a doctor ever told them that they had a stroke. In the US, at follow-up, a question asked whether a doctor or other health professional newly diagnosed them as having a stroke. In the MIDUS, participants indicated whether they experienced or had been treated for stroke in the past 12 months. The NHATS asked whether a doctor told them that they had a stroke since the last interview. In the LISS, participants were asked whether they were told by a physician this last year that they suffered from a stroke or brain infarction, or a disease affecting the blood vessels in the brain. Answers were reported with a yes/no format in each sample.

Covariates

In the 6 samples, age (in years), sex (coded as 1 for female and 0 for male), and education were controlled. Years of education

were reported in the HRS and WLS, MIDUS used a scale from 1 (no grade school) to 12 (doctoral level degree), NHATS used a scale from 1 (no schooling completed) to 9 (Master's, professional or doctoral degree), LISS used a scale from 1 (primary school) to 6 (University), and US used a scale from 0 (none reported) to 16 (higher degree). Race was controlled for in HRS, MIDUS, NHATS (all coded 1 for Black and 0 for other) and US (coded 1 for non-White and 0 for other). Ethnicity (coded 1 for Hispanic and 0 for not Hispanic) was included as a covariate in HRS and NHATS.

Additional analyses included smoking, BMI, diabetes, blood pressure, and physical activity as covariates. Smoking was coded as 1 for current/former smoker and 0 for never smoker in all samples. BMI was computed as kg/m^2 based on self-reported height and weight in MIDUS, WLS, LISS, and NHATS and on staff-assessed weight and height in HRS and US. Participants also indicated whether they had been diagnosed with diabetes or high blood pressure (yes/no) in all samples. In the HRS, 2 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) were averaged. In the MIDUS, participants were asked to indicate the frequency of their vigorous and moderate leisure physical activity during both the summer and winter months. Answers on a scale from 1 (never) to 6 (several times a week or more) were averaged. In the NHATS, participants indicated whether they ever go walking for exercise and whether they ever spent time on vigorous activities in the last month. For each item, answers were given using a yes/no format and summed. In the WLS, participants were asked how often they participated in light and vigorous physical activity using a scale ranging from 1 (less than once per month) to 4 (3 or more times per week). In the US cohort, an item asked participants how often in the last 12 months they did sport, on a scale ranging from 1 (do not do any sport) to 7 (more than 3 times a week). In the LISS, 2 items that asked how many days a week participants performed strenuous and moderate activities were averaged.

Statistical Analysis

Cox proportional hazard survival models were used to test whether personality traits were associated with risk of incident stroke in the 6 samples. Time-to-incidence was coded in years from baseline to the year in which participants were diagnosed with stroke. Participants who had no stroke were censored at the last available assessment. Personality traits were entered as predictors of time-to-incidence in separate analyses. Age, sex, and education were controlled in the 6 samples. Race was controlled in the MIDUS, the HRS, the NHATS, and the US. Ethnicity was controlled in the HRS and the NHATS. Additional Cox survival analyses were conducted including clinical and behavioral covariates. The interactions between predictors and time were tested to evaluate the proportional hazards assumption. The proportional hazard assumption was met in the 6 samples. Random-effect meta-analyses were conducted with the Comprehensive Meta-Analysis software. I^2 indicator was used to quantify heterogeneity between samples.

Sensitivity analyses excluded participants with stroke-related mortality. Causes of mortality were available in the MIDUS and the HRS. In the MIDUS, causes of death were based on the *International Classification of Disease Ninth (ICD-9) and Tenth (ICD-10)* revisions. Individuals coded as I60-I69 (stroke) were excluded from the analysis. In the HRS, causes of death were categorized based on *ICD-10* were available up to 2016. Participants with the code 123 (stroke; cerebral hemorrhage or accident; hematoma (if related to brain); transient ischemic attack) were excluded.

RESULTS

The median follow-up was 17.83 years (58 580 person-years; MIDUS), 10.34 years (109 034 person-years; HRS), 7.87 years (176 747 person-years; US), 17.33 years (143 607 person-years; WLS), 5.92 years (11 911 person-years; NHATS), and 9 years (40 652 person-years; LISS). The percentage of individuals who had a stroke over time was 2% (N=68; MIDUS), 10% (N=1140; HRS), 1% (N=359; US), 5% (N=413; WLS), 10% (N=242; NHATS), and 2% (N=91; LISS).

Consistent with the hypothesis, the meta-analysis indicated that higher neuroticism was associated with higher incident stroke, whereas higher conscientiousness was associated with lower risk of incident stroke, controlling for demographic factors (Table 2). There was little evidence of heterogeneity across the samples. Neuroticism was related to incident stroke in 5 out of 6 samples; conscientiousness was significantly associated with stroke in 4 out of 6 samples (Table 2). The results suggested that 1 SD higher neuroticism was associated with 11% to 35% higher risk of incident stroke, and 1 SD higher conscientiousness was associated with 11% to 39% lower risk of incident stroke.

Smoking, BMI, physical activity, blood pressure, and diabetes partially accounted for the associations between personality traits and incident stroke, which remained significant even after accounting for these behavioral and clinical covariates (Table 3). Extraversion, openness, or agreeableness were unrelated to risk of incident stroke in all samples (Tables 2 and 3). The Figure shows a forest plot with the effects from each sample and the overall meta-analytic effect for neuroticism and conscientiousness adjusting for demographic covariates (Figure [A] and [B]) and adjusting for demographic, clinical and behavioral covariates (Figure [C] and [D])).

The pattern of association was unchanged when participants with mortality-related stroke were excluded in the MIDUS (HR $_{neuroticism}$, 1.32 [95% CI, 1.03–1.69]; P=0.026; HR$_{conscientiousness}$, 0.76 [95% CI, 0.61–0.96]; P=0.019) and the HRS (HR $_{neuroticism}$, 1.13 [95% CI, 1.07–1.21]; P<0.001; HR$_{conscientiousness}$, 0.89 [95% CI, 0.84–0.95]; P<0.001).

DISCUSSION

Based on 6 longitudinal samples of more than 55 000 adults, the present study found that higher neuroticism was associated with a higher risk of incident stroke,

Table 2. Summary of Cox Regression Analysis Predicting Risk of Incident Stroke From Personality Traits in the 6 Samples

	MIDUS *	HRS†	US*	WLS‡	NHATS†	LISS‡	Pooled hazard ratio	Heterogeneity I^2
Neuroticism	1.35§ (1.06–1.72)	1.14¶ (1.07–1.21)	1.19‖ (1.08–1.32)	1.11§ (1.01–1.23)	1.17§ (1.03–1.33)	1.14 (0.93–1.41)	1.15¶ (1.10–1.20)	0
Extraversion	0.90 (0.71–1.14)	0.96 (0.91–1.02)	1.05 (0.95–1.16)	0.93 (0.84–1.02)	1.04 (0.91–1.18)	1.06 (0.86–1.32)	0.98 (0.94–1.02)	3.83
Openness	1.07 (0.83–1.36)	0.95 (0.90–1.01)	0.99 (0.90–1.10)	1.00 (0.90–1.10)	0.96 (0.84–1.09)	1.04 (0.84–1.29)	0.97 (0.93–1.01)	0
Agreeableness	0.96 (0.75–1.24)	0.99 (0.93–1.05)	0.99 (0.89–1.10)	0.98 (0.89–1.08)	0.99 (0.87–1.12)	1.08 (0.86–1.36)	0.99 (0.95–1.03)	0
Conscientiousness	0.72‖ (0.58–0.90)	0.90¶ (0.85–0.96)	0.93 (0.84–1.03)	0.89§ (0.81–0.98)	0.84‖ (0.74–0.95)	0.96 (0.77–1.19)	0.89¶ (0.85–0.93)	9.93

MIDUS: N=3960; HRS: N=11 015; US: N=27 066; WLS: N=8823; NHATS: N=2319; LISS=4922. HRS indicates Health and Retirement Study; LISS, Longitudinal Internet Studies for the Social Sciences; MIDUS, Midlife in the United States Study; NHATS, National Health and Aging Trends Study; US, Understanding Society; and WLS, Wisconsin Longitudinal Study.

*Adjusted for age, sex, education, and race.

†Adjusted for age, sex, education, race, and ethnicity.

‡Adjusted for age, sex, and education.

§P<0.05, ‖P<0.01, ¶P<0.001.

whereas conscientiousness was associated with a lower risk of stroke. These associations were observed across different samples of different ages, from different countries, over 7 to 20 years of follow-up, controlling for demographic factors, and persisted when clinical and behavioral risk factors were included in the analyses. The present study adds to existing knowledge on the association between personality and stroke[25,27] by testing the largest overall sample with the longest follow-up.

Several clinical and behavioral pathways could explain the link between neuroticism and conscientiousness and stroke. Indeed, higher neuroticism is related to higher BMI,[21] higher risk of diabetes and hypertension,[20] smoking,[22] and physical inactivity,[23] which are leading clinical and behavioral causes of stroke.[1,7] In contrast, higher conscientiousness is associated with more beneficial clinical and behavioral profiles implicated in incident stroke, such as lower risk of obesity,[21] smoking,[22] diabetes, and hypertension,[20] and higher physical activity.[23] The additional analysis supported this pathway because these clinical and behavioral factors accounted for some of the association between personality and incident stroke. However, other biological and psychological mechanisms may explain these associations. For example, higher neuroticism and lower conscientiousness are associated with higher systemic inflammation,[12] which is implicated in incident stroke.[32] Based upon recent evidence,[33] a stress-related pathway through heightened negative affect reactivity to everyday stressful experiences may also explain part of the association between higher neuroticism and lower conscientiousness and incident stroke over time.

Extraversion, openness, and agreeableness were unrelated to stroke incidence. Although openness was

Table 3. Summary of Cox Regression Analysis Predicting Risk of Incident Stroke From Personality Traits in the 6 Samples, Controlling for Behavioral and Clinical Factors

	MIDUS*	HRS†	US*	WLS‡	NHATS†	LISS‡	Pooled hazard ratio	Heterogeneity I^2
Neuroticism	1.42§ (1.09–1.86)	1.08§ (1.01–1.15)	1.34‖ (1.09–1.65)	1.04 (0.94–1.15)	1.14 (1.00–1.30)	1.12 (0.91–1.37)	1.13‖ (1.05–1.21)	44.37
Extraversion	1.00 (0.61–1.30)	1.02 (0.95–1.09)	0.87 (0.71–1.06)	0.96 (0.87–1.06)	1.08 (0.95–1.23)	1.05 (0.85–1.30)	1.00 (0.96–1.05)	0
Openness	1.12 (0.86–1.46)	0.98 (0.92–1.05)	0.88 (0.71–1.08)	1.02 (0.92–1.14)	0.98 (0.86–1.12)	1.04 (0.84–1.30)	0.99 (0.95–1.04)	0
Agreeableness	0.95 (0.73–1.23)	1.02 (0.96–1.10)	0.88 (0.72–1.08)	1.04 (0.94–1.15)	1.03 (0.90–1.17)	1.07 (0.85–1.35)	1.02 (0.97–1.07)	0
Conscientiousness	0.73§ (0.58–0.93)	0.95 (0.89–1.01)	0.93 (0.76–1.14)	0.95 (0.86–1.05)	0.86§ (0.76–0.98)	0.99 (0.80–1.23)	0.92‖ (0.87–0.98)	17.89

MIDUS: N=2870; HRS: N=9239; US: N=8278; WLS: N=8467; NHATS: N=2251; LISS=4907. Diabetes, blood pressure/hypertension, physical inactivity, BMI, and smoking were controlled in the 6 samples.

*Adjusted for age, sex, education, and race.

†Adjusted for age, sex, education, race, and ethnicity.

‡Adjusted for age, sex, and education.

§P<0.05, ‖P<0.01.

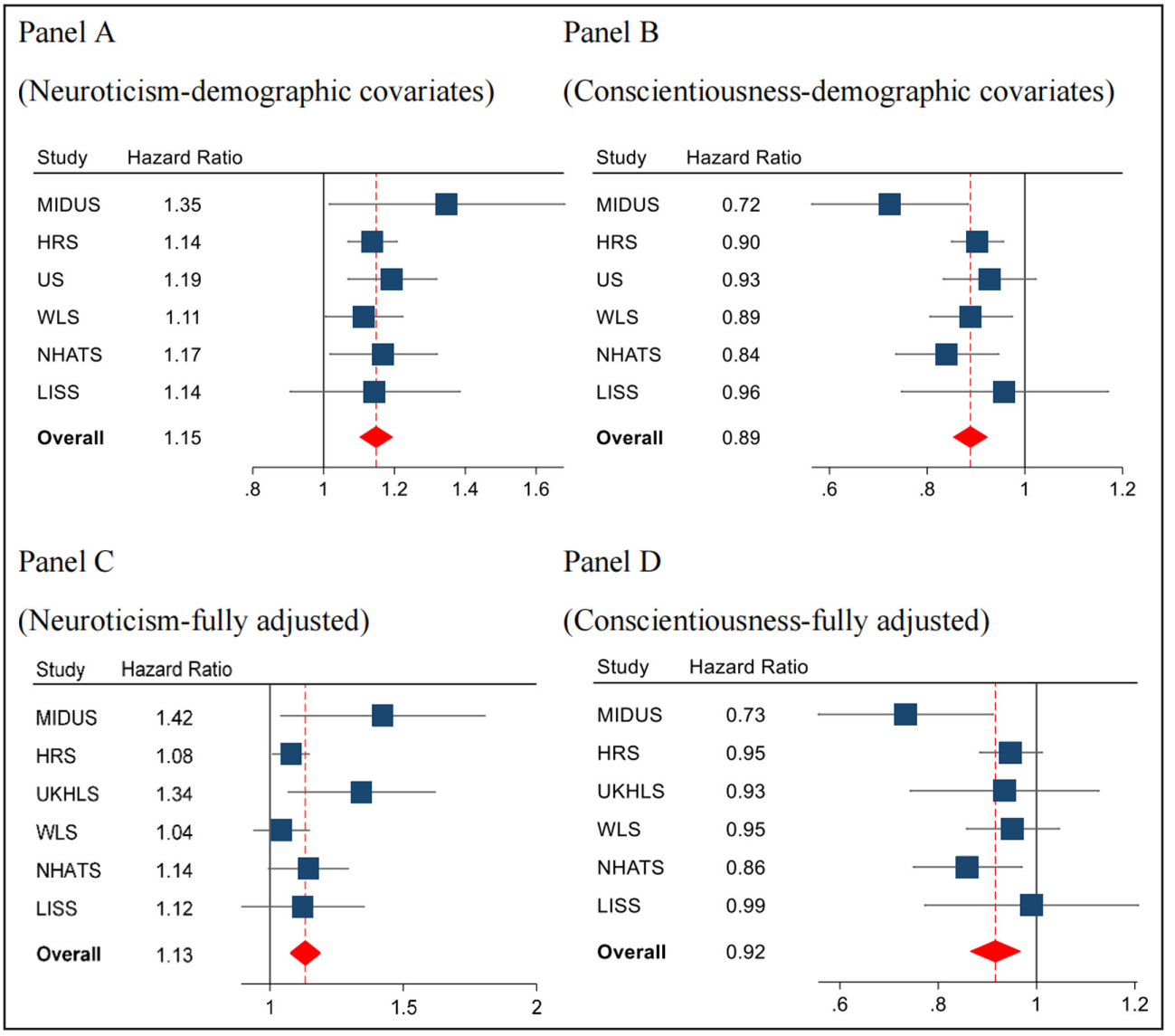

Figure. Forest plot of the associations of neuroticism and conscientiousness with risk of incident stroke without and with accounting for behavioral and clinical factors.

HRS indicates Health and Retirement Study; LISS, Longitudinal Internet Studies for the Social Sciences; MINDUS, Midlife in the United States Study; NHATS, National Health and Aging Trends Study; and WLS, Wisconsin Longitudinal Study.

related to lower risk of incident stroke in 1 previous study,[27] this association was not found in any of the 6 large samples we examined in this study. There is inconsistent or no evidence for a relationship between these traits and cardiovascular risk factors such as blood pressure or diabetes,[34,35] which may explain the lack of association with stroke incidence in the present study.

This study had several limitations. Stroke diagnosis was based on participant report of a stroke diagnosis by a doctor or other health professional and was defined differently across cohorts. Future research is needed to test whether the pattern of associations replicates with medical records. The present study also cannot completely exclude that reverse causality may contribute to the observed associations. Indeed, the underlying pathological changes associated with stroke could lead to higher neuroticism and lower conscientiousness before diagnosis. Contrary to the reverse causality hypothesis, however, the size of the association between personality and incident stroke was urelated to follow-up length. Additional limitations include residual confounding, positive selection effect, data comparability, and the biases related to I^2 statistic with the small number of samples included. Finally, future research needs to use more inclusive samples across race and include samples from low and middle income countries.

Despite these limitations, the present research found replicated evidence that higher neuroticism and lower

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conscientiousness were associated with higher risk of incident stroke. Personality assessment could help identify individuals at risk of stroke and provide insights for tailored interventions. Individuals with higher neuroticism and lower conscientiousness may benefit from behavioral interventions, such as physical activity or smoking cessation programs, which may ultimately lead to lower risk of stroke.

ARTICLE INFORMATION

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