


Personality traits and the risk of urinary incontinence: Evidence from three longitudinal samples

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Abstract

Objective: Urinary incontinence (UI) is a common condition with a substantial negative impact on older adults' quality of life. This study examines whether individual differences in behavioral, cognitive, and emotional traits assessed by the five major dimensions of personality are related to the risk of concurrent and incident UI.

Methods: Participants were older women and men ($N > 26,000$) from the Midlife in the United States Survey, the Health and Retirement Study, and the English Longitudinal Study of Aging. In each cohort, personality traits (measured with the Midlife Development Inventory) and demographic (age, sex, education, and race), clinical (body mass index, diabetes, blood pressure), and behavioral (smoking) factors were assessed at baseline. UI was assessed at baseline and again 8–20 years later. Results for each cohort were combined in random-effect meta-analyses.

Results: Consistently across cohorts, higher neuroticism and lower conscientiousness were related to a higher risk of concurrent and incident UI. To a lesser extent, extraversion, openness, and agreeableness were also related to lower risk of concurrent and incident UI. BMI, diabetes, blood pressure, and smoking partially accounted for these associations. There was little evidence that age or sex moderated the associations.

Conclusions: The present study provides novel, robust, and replicable evidence linking personality traits to UI. The higher vulnerability for UI for individuals who score higher on neuroticism and lower on conscientiousness is consistent with findings for other multifactorial geriatric syndromes. Personality traits can help identify individuals at risk and may help contextualize the clinical presentation of comorbid emotional, cognitive, and behavioral symptoms.

KEYWORDS

geriatric syndrome, personality, urinary incontinence

Key points

- In three large samples of middle-aged and older adults and a meta-analysis, the present study provides replicable evidence for an association between personality traits and risk of Urinary incontinence (UI)
- Higher neuroticism was related to a higher risk of concurrent and incident UI
- Higher extraversion, openness, agreeableness, and conscientiousness were related to lower risk of concurrent and incident UI

1 | INTRODUCTION

Urinary incontinence (UI) is a highly prevalent and complex geriatric syndrome, with critical implications for older individuals' quality of life.^{1,2} UI has been associated with a range of outcomes, including higher anxiety and depressive symptoms,³ loneliness,⁴ more limitations in activities of daily living,⁵ higher risk of frailty,⁶ falls⁷ and ultimately higher risk of early mortality.⁸ Therefore, there is a need to better understand the factors associated with an increased risk of UI to design effective preventive actions. There is strong evidence for a heightened risk of incontinence among older adults, women, and individuals with lower education.^{9,10} In addition to these demographic factors, diabetes, hypertension, higher body mass index (BMI), and smoking are major clinical and behavioral risk factors for UI.⁹ However, less is known about the extent to which psychological factors are related to UI risk. Therefore, the present study aims to address this gap by examining whether personality traits, which are relatively enduring patterns of thoughts, feelings, and behaviors, are associated with concurrent and incident risk of UI.

The personality traits defined by the Five-Factor Model¹¹ have broad associations with health across adulthood,¹² including geriatric syndromes. In particular, high neuroticism (the tendency to experience vulnerability to stress and negative emotions, such as sadness and anxiety) and low conscientiousness (the tendency to be organized, self-disciplined, and responsible) are the traits with the most consistent associations with higher risk of frailty,^{13,14} ADL and IADL limitations,^{15,16} incident falls,¹⁷ depression,¹⁸ and cognitive impairment and dementia.¹⁹ Higher extraversion (the tendency to be outgoing and to experience positive emotions) and higher openness (the tendency to be imaginative and curious), have been associated with lower risk of frailty¹⁴ and incident functional limitations,¹⁵ but the associations are less consistent across studies or across geriatric syndromes.¹³ Agreeableness (the tendency to be trusting and altruistic) tends to be unrelated to geriatric syndromes.^{13,17,19}

To the best of our knowledge, no study has yet tested whether Five-Factor Model personality traits are related to the risk of UI. Besides the association with age-related conditions and geriatric syndromes, there are conceptual reasons to expect an association between personality and UI. First, the basic tendencies associated with neuroticism and conscientiousness may be directly related to bladder control and the risk of UI. For example, neuroticism is characterized by a heightened vulnerability to stress and a higher propensity to experience anxiety,¹¹ which could lead to reduced bladder control and higher risk of UI.^{20,21} Lower conscientiousness is characterized by lower self-control and lower impulse control,²² which could manifest into lower bladder control and higher risk of UI. In addition, lower conscientiousness has been related to physiologically-based insensitivity to internal signals,²³ which could be expressed in reduced brain sensitivity to signals from the bladder and ultimately to higher risk of UI. The association between personality and UI may also operate through indirect brain, clinical and behavioral pathways. Both higher neuroticism and lower conscientiousness are related to lower brain health, including markers of

neuronal injury (neurofilament light) and astrogliosis (glial fibrillary acidic protein),²⁴ which could interfere with the processing of bladder signals, leading to higher risk of UI. Personality has also been associated with the leading clinical and behavioral risk factors for UI. For example, higher neuroticism and lower extraversion and conscientiousness have been associated with higher BMI,²⁵ which is a strong risk factor for UI.⁹ Furthermore, higher neuroticism and lower conscientiousness have been related to higher likelihood of diabetes and hypertension²⁶ and smoking,²⁷ which are associated with higher risk of UI.⁹

Based on three large longitudinal samples of older adults, the present study examined the associations between personality and concurrent and incident UI. This multi-sample, coordinated analysis allows us to assess the replicability and generalizability of the association between personality and incontinence across different samples, age ranges, scales, time intervals, and cultures. This research was guided by the question: How are personality traits associated with concurrent and incident UI? It was hypothesized that higher neuroticism would be related to higher risk of concurrent and incident UI, whereas conscientiousness was expected to be related to a lower risk of both concurrent and incident UI. No hypotheses were made for extraversion, openness, and agreeableness. Additional analyses tested whether clinical (e.g., diabetes, blood pressure, BMI) and behavioral (smoking) factors accounted for the association between personality and both concurrent and incident UI. Exploratory analyses were conducted to test whether the association between personality and risk of UI was moderated by age and sex.

2 | METHOD

2.1 | Participants

The present study uses publicly available de-identified data from three large longitudinal samples: The Midlife In the United States study (MIDUS), the Health and Retirement Study (HRS), and the English Longitudinal Study of Aging (ELSA). The three samples were chosen because they included personality and longitudinal assessment of UI and were freely available. Each sample had data at baseline on all variables and follow-up data on UI. The MIDUS Study was approved by the Education and Social/Behavioral Sciences and the Health Sciences Institutional Review Board (IRB) at the University of Wisconsin-Madison. The HRS was approved by the University of Michigan IRB. The National Research Ethics Service approved ELSA. In the three samples, participants provided written informed consent. The present study was exempt from IRB review because it used publicly available de-identified, anonymized data. Table 1 presents a summary of descriptive statistics for the three samples.

The MIDUS is a longitudinal study of non-institutionalized US adults. Baseline data were obtained from the first wave (MIDUS 1, 1994–1995). Complete data were obtained from 6058 participants aged from 20 to 75 years (52% women, mean Age = 46.79, SD = 12.88), which is about 85% of the overall sample. Follow-up

TABLE 1 Baseline characteristics of the samples.

Variables	MIDUS		HRS		ELSA	
	M/%	SD	M/%	SD	M/%	SD
Age (Years)	46.79	12.88	68.58	9.90	66.10	8.69
Sex (% women)	52%	-	58%	-	55%	-
Race (% African American)	5%	-	11%	-	2% ^a	-
Education	6.88	2.47	12.80	2.97	4.17	2.23
Neuroticism	2.24	0.66	2.05	0.61	2.10	0.59
Extraversion	3.20	0.56	3.19	0.56	3.15	0.56
Openness	3.02	0.53	2.94	0.56	2.88	0.55
Agreeableness	3.49	0.49	3.53	0.48	3.51	0.48
Conscientiousness	3.42	0.44	3.36	0.48	3.30	0.49
Urinary incontinence (%)	17%	-	23%	-	14%	-
Incident urinary incontinence (%) ^b	35%	-	39%	-	25%	-

Note: MIDUS: N = 6058; HRS: N = 12,652; ELSA: N = 8116.

^a% non-white.

^bIndividuals who reported UI at baseline were excluded. Education was assessed on a scale from 1 (no grade school) to 12 (doctoral level degree) in the MIDUS, in years in the HRS, and from 1 (No qualification) to 7 (NVQ4/NVQ5/Degree or equivalent) in ELSA. See Method section for differences in measures.

data on UI were collected at the second (MIDUS II, 2004–2006) and third (MIDUS III, 2013–2014) wave of the MIDUS. Of the baseline sample, 3937 participants had information on UI at follow-up.

The HRS is a nationally representative longitudinal study of Americans 50 years and older and their spouse. Baseline data were obtained from a random half of the sample in 2006 and from the other half in 2008. The baseline sample was the combination of both waves, and included 12,652 participants aged from 50 to 104 years (58% women, Mean age = 68.58; SD = 9.90) with complete data, which is about 69% of the overall sample. Urinary incontinence was assessed at every 2-year wave up to the 2020 wave. Of the baseline sample, a total of 11,736 participants provided data on UI at follow-up.

ELSA is a nationally representative longitudinal panel study of men and women living in England aged 50 years and over. Complete baseline data were obtained at Wave 5 in 2010/2011 from a total of 8116 participants aged from 50 to 89 years (55% women, mean Age = 66.10; SD = 8.69), which is about 79% of the overall sample. Follow-up data on UI were obtained every 2 years up to Wave 9 (2018/2019). From the baseline sample, a total of 7414 participants had data on UI at follow-up.

2.2 | Personality

Personality traits were assessed in the three samples using the Midlife Development Inventory (MIDI).²⁸ A 25-item version was used in the MIDUS, whereas a 26-item version was used in the HRS and ELSA. Participants were asked to indicate the extent to which adjectives referring to neuroticism (nervous), extraversion (outgoing), openness (curious), agreeableness (softhearted), and conscientiousness

(responsible) described them using a scale from 1 (*not at all*) to 4 (*a lot*). The mean was calculated across items for each trait in each sample. Cronbach alphas in the MIDUS, HRS, and ELSA were respectively 0.74, 0.71, and 0.68 for neuroticism; 0.78, 0.75, and 0.76 for extraversion; 0.78, 0.79, and 0.76 for openness; 0.81, 0.79, and 0.80 for agreeableness; and 0.58, 0.67, and 0.68 for conscientiousness.

2.3 | Urinary incontinence

In MIDUS, participants were asked: “During the past 30 days, how often have you experienced leaking urine?” Answers were given on a scale ranging from “not all at all,” “once a month,” “several times a month,” “once a week,” “several times a week,” and “almost everyday.” Answers of “once a month,” “several times a month,” “once a week,” “several times a week,” and “almost everyday” were recoded to 1 and “not at all” was coded as 0. In the HRS, participants were asked to answer the following question: “This might not be easy to talk about, but during the last 12 months, have you lost any amount of urine beyond your control?” In ELSA, participants were asked “during the last 12 months, have you lost any amount of urine beyond your control?” In both HRS and ELSA, answers were given on a yes/no format.

2.4 | Covariates

In the three samples, age in years, sex (0 = male, 1 = female), education and race were controlled for in the analyses. Education was assessed on a scale from 1 (no grade school) to 12 (doctoral level

degree) in the MIDUS and from 1 (No qualification) to 7 (NVQ4/NVQ5/Degree or equivalent) in ELSA. Years of education were reported in the HRS. Race was coded as 1 “African American” and 0 “other” in MIDUS and HRS, and as 1 “non-White” and 0 “white” in ELSA. Additional analyses controlled for BMI, diabetes, blood pressure, and smoking. Staff-assessed weight and height were used to compute BMI (kg/m^2) in HRS and ELSA, whereas self-reported height and weight were used in MIDUS. In the three samples, participants self-reported a diagnosis of diabetes or high blood pressure with a yes/no format. Smoking was coded as 1 for current/former smokers and 0 for never-smokers. Additional analysis included disease burden as a covariate. In the three samples, disease burden was the sum of diagnosed diseases and conditions (see Supporting Information S1 for the complete list of conditions assessed in each sample).

2.5 | Statistical analysis

Logistic regression analysis was used to test whether personality traits were related to the likelihood of UI at baseline. In each sample, age, sex, education, and race were included as covariates. Personality traits were standardized as z-scores and examined separately. BMI, diabetes, high blood pressure, and smoking were included as covariates in additional analyses.

The association between personality traits and incident UI was examined using Cox proportional hazard models. Participants with UI at baseline were excluded from the analysis. Among participants without UI at baseline, time-to-incident was coded as years from baseline to the year of the first reported UI. Participants without incident UI were censored at the last available assessment. Personality traits were z-scored and examined in separate analyses. Demographic factors (age, sex, education and race) were controlled. Additional analyses further controlled for clinical and behavioral covariates. The results from each sample were combined in random-effect meta-analyses using the Comprehensive Meta-Analysis software. Additional analyses were conducted to test whether age and sex moderated the association between personality and both concurrent and incident UI by testing an interaction between age or sex and each trait. Supplementary analyses were conducted to control for disease burden in addition to BMI and smoking.

Sensitivity analyses were conducted to examine the association between personality and the risk of stress and urgency incontinence at baseline in the HRS (data were not available in MIDUS and ELSA). Data on both stress and urgency incontinence were not available over the full follow-up of the study. The question: “How often did you leak with an urge to urinate and could not get to the bathroom fast enough?” was used to assess urgency incontinence and the question: “How often did you leak with activities such as coughing, laughing or sneezing?” assessed stress incontinence. For both questions, answers of “most of the time” or “some of the time” were coded as 1 (stress/urgency incontinence). Individuals without UI and those who answered rarely or never were coded as “0 (no stress/urgency incontinence).”²⁹ Logistic regression was used to examine the

association between personality and the likelihood of either stress or urgency incontinence, controlling for demographic factors.

3 | RESULTS

3.1 | Cross-sectional associations

At baseline, 17%, 23%, and 14% of individuals reported UI in the MIDUS, the HRS, and ELSA, respectively. As hypothesized, higher neuroticism was related to a higher likelihood of concurrent UI, whereas higher conscientiousness was associated with a lower risk of concurrent incontinence (Table 2, Model 1). These associations were found across the three samples and the meta-analysis. The results suggested that a one SD higher neuroticism was related to a 26%–41% higher risk of UI at baseline, whereas a one SD higher conscientiousness was associated with a 28%–37% lower likelihood of concurrent UI. Unexpectedly, higher extraversion, openness, and agreeableness were related to a lower likelihood of UI at baseline across the three samples and the meta-analysis (Table 2, Model 1). One SD higher extraversion, openness, and agreeableness were related to 20%–30%, 8%–19%, and 5%–15% lower likelihood of concurrent UI, respectively. The overall pattern of associations was almost unchanged in analyses that included clinical and behavioral covariates (Table 2, Model 2) or disease burden (Table S1).

There was little replicable evidence for interactions between personality and either age or sex. Agreeableness was more strongly related to a lower likelihood of concurrent UI among older individuals in the MIDUS (OR: 0.89; 95% CI: 0.82–0.96, $p < 0.01$) and the HRS (OR: 0.94, 95% CI: 0.90–0.98, $p < 0.01$). Conscientiousness was more strongly associated with a lower risk of concurrent incontinence among older adults in the MIDUS (OR: 0.90; 95% CI: 0.84–0.97, $p < 0.01$). Extraversion (OR: 0.86, 95% CI: 0.73–1.00, $p < 0.05$) and openness (OR: 0.83, 95% CI: 0.71–0.97, $p < 0.05$) were more strongly related to lower likelihood of baseline UI among women in the MIDUS, whereas the link between conscientiousness and a reduced risk of concurrent UI was stronger among male in ELSA (OR: 1.15; 95% CI: 1.01–1.31, $p < 0.05$).

3.2 | Prospective associations

Among participants without UI at baseline, the percentage who had incident UI over time was 35% ($N = 1139$) in MIDUS, 39% ($N = 3505$) in HRS, and 25% ($N = 1567$) in ELSA. The median follow-up was 16.91 years (43,948 person-years) in MIDUS, 8.08 years (73,675 person-years) in HRS, and 7.58 years (38,189 person-years) in ELSA. As hypothesized, higher neuroticism was associated with a higher risk of incident UI, whereas higher conscientiousness was related to a reduced risk of incident UI consistently across samples (Table 3, Model 1). A one SD higher score on neuroticism was associated with a 14%–19% higher risk of incident UI, and a one SD higher conscientiousness was associated with 8%–20% lower risk of incident UI.

TABLE 2 Odds ratios from logistic regression analysis predicting baseline urinary incontinence (UI) from baseline personality traits.

	MIDUS		HRS		ELSA		Pooled odds ratios		Heterogeneity I ²	
	Model 1 ^a	Model 2 ^b	Model 1 ^a	Model 2 ^b	Model 1 ^a	Model 2 ^b	Model 1	Model 2	Model 1	Model 2
Neuroticism	1.41*** (1.31–1.52)	1.40*** (1.28–1.53)	1.26*** (1.21–1.32)	1.25*** (1.19–1.31)	1.38*** (1.29–1.47)	1.41*** (1.31–1.52)	1.34*** (1.24–1.45)	1.34*** (1.23–1.47)	79.78	79.04
Extraversion	0.83*** (0.77–0.89)	0.84*** (0.78–0.92)	0.83*** (0.79–0.86)	0.83*** (0.79–0.87)	0.77*** (0.72–0.82)	0.77*** (0.71–0.82)	0.81*** (0.77–0.85)	0.82*** (0.78–0.86)	45.99	35.62
Openness	0.85*** (0.79–0.92)	0.88*** (0.81–0.96)	0.93*** (0.89–0.97)	0.92*** (0.88–0.97)	0.84*** (0.79–0.90)	0.81*** (0.76–0.88)	0.88*** (0.81–0.94)	0.87*** (0.80–0.95)	77.84	81.66
Agreeableness	0.92* (0.85–0.99)	0.96 (0.88–1.05)	0.95* (0.90–0.99)	0.94* (0.89–0.99)	0.87*** (0.82–0.93)	0.86*** (0.80–0.93)	0.92** (0.87–0.97)	0.92** (0.86–0.98)	56.31	56.46
Conscientiousness	0.75*** (0.70–0.81)	0.78*** (0.72–0.85)	0.78*** (0.75–0.82)	0.81*** (0.77–0.85)	0.73*** (0.69–0.78)	0.74*** (0.69–0.80)	0.76*** (0.72–0.79)	0.78*** (0.74–0.82)	49.60	55.43

Note: Odds ratio (95% confidence intervals) are reported.

^aModel 1: Adjusted for age, sex, education, and race; MIDUS: N = 6058; HRS: N = 12,652; ELSA: N = 8116.

^bModel 2: Adjusted for age, sex, education, race, diabetes, blood pressure, BMI and smoking; MIDUS: N = 4395; HRS: N = 10,615; ELSA: N = 6352.

*p < 0.05, **p < 0.01, ***p < 0.001.

TABLE 3 Hazard ratios from cox regression analysis predicting incident urinary incontinence (UI) from baseline personality traits.

	MIDUS		HRS		ELSA		Pooled hazard ratios		Heterogeneity I ²	
	Model 1 ^a	Model 2 ^b	Model 1 ^a	Model 2 ^b	Model 1 ^a	Model 2 ^b	Model 1	Model 2	Model 1	Model 2
Neuroticism	1.14*** (1.08–1.21)	1.14*** (1.07–1.23)	1.14*** (1.10–1.18)	1.12*** (1.08–1.17)	1.19*** (1.13–1.25)	1.20*** (1.13–1.27)	1.15*** (1.12–1.18)	1.15*** (1.10–1.20)	3.93	48.75
Extraversion	0.92** (0.87–0.97)	0.92* (0.86–0.99)	0.92*** (0.89–0.96)	0.94** (0.91–0.98)	0.85*** (0.81–0.89)	0.86*** (0.82–0.91)	0.90*** (0.85–0.94)	0.91*** (0.86–0.96)	75.06	66.10
Openness	0.92** (0.87–0.98)	0.92* (0.86–0.99)	0.98 (0.95–1.01)	0.99 (0.95–1.03)	0.89*** (0.85–0.94)	0.89*** (0.84–0.95)	0.93* (0.87–0.99)	0.94 (0.87–1.00)	79.99	75.93
Agreeableness	0.96 (0.91–1.02)	0.97 (0.91–1.05)	0.97 (0.94–1.01)	0.97 (0.94–1.01)	0.93** (0.89–0.98)	0.92** (0.87–0.97)	0.96** (0.93–0.98)	0.95** (0.92–0.99)	0	20.39
Conscientiousness	0.93* (0.88–0.99)	0.92* (0.86–0.99)	0.88*** (0.86–0.91)	0.91*** (0.88–0.94)	0.83*** (0.79–0.87)	0.85*** (0.80–0.89)	0.88*** (0.83–0.93)	0.89*** (0.85–0.93)	75.32	54.70

Note: Hazard ratios (95% confidence intervals) are reported.

^aModel 1: Adjusted for age, sex, education, and race; MIDUS: N = 3227; HRS: N = 9055; ELSA: N = 6358.

^bModel 2: Adjusted for age, sex, education, race, diabetes, blood pressure, BMI and smoking; MIDUS: N = 2336; HRS: N = 7700; ELSA: N = 5063.

*p < 0.05, **p < 0.01, ***p < 0.001.

The meta-analysis indicated that extraversion, openness, and agreeableness were also associated with a lower risk of incident UI (Table 3, Model 1). The association with extraversion was significant in all three samples, the association with openness was significant in two out of three samples, and the association with agreeableness was significant in only one sample. Specifically, a one SD higher extraversion was associated with 9%–18% lower risk of incident UI, and openness was associated with a 9%–12% lower risk of incident UI, whereas a one SD higher agreeableness was related to 8% lower risk of incident UI in ELSA. The overall pattern of association was generally the same in additional analyses that included the clinical and behavioral covariates (Table 3, Model 2), as well as disease burden (Table S1). The association between higher agreeableness and lower risk of incident UI was stronger among older adults in the MIDUS (HR: 0.92, 95% CI: 0.87–0.98, $p < 0.01$) and the HRS (HR: 0.96, 95% CI = 0.93–0.99, $p < 0.05$).

3.3 | Sensitivity analyses

Sensitivity analyses examined whether personality was related to different experiences of incontinence in the HRS. The results indicated that higher neuroticism was related to a higher risk of stress (OR: 1.35, 95% CI: 1.27–1.43, $p < 0.001$) and urgency incontinence (OR: 1.41, 95% CI: 1.33–1.50, $p < 0.001$). Higher extraversion (OR: 0.84, 95% CI: 0.79–0.90, $p < 0.001$), higher openness (OR: 0.94, 95% CI: 0.88–1.00, $p < 0.05$), and higher conscientiousness (OR: 0.75, 95% CI: 0.71–0.80, $p < 0.001$) were related to a lower risk of stress incontinence. Higher extraversion (OR: 0.75, 95% CI: 0.71–0.79, $p < 0.001$), higher openness (OR: 0.87, 95% CI: 0.82–0.92, $p < 0.001$), higher agreeableness (OR: 0.89, 95% CI: 0.84–0.95, $p < 0.001$), and higher conscientiousness (OR: 0.72, 95% CI: 0.68–0.76, $p < 0.001$) were associated with a lower risk of urgency incontinence. Higher agreeableness was not associated with stress incontinence (OR: 0.96, 95% CI: 0.90–1.02, $p = 0.20$).

4 | DISCUSSION

Based on three large longitudinal samples of middle-aged and older adults, the present study examined whether personality is associated with concurrent and incident UI. In line with the hypotheses, higher neuroticism was related to a higher risk of concurrent and incident UI, whereas higher conscientiousness was associated with a lower likelihood of concurrent and incident UI. Unexpectedly, higher extraversion, openness, and agreeableness were also associated with lower risk of both concurrent and incident UI. The association between personality and UI was robust because it was observed even when controlling for demographic, clinical, and behavioral risk factors and in concurrent and longitudinal analyses over follow-ups that ranged from 8 to 20 years. The association was also replicable because the same pattern was observed across three cohorts and across sex and age. The present study provides novel evidence of an

association between personality and risk of UI that is robust and replicable.

Neuroticism, extraversion, and conscientiousness were the most consistent personality correlates of risk of concurrent and incident UI across the three samples. This finding extends existing knowledge on the association between personality traits and other geriatric syndromes such as frailty^{13,14} and falls¹⁷ and pre-dementia syndromes, such as motoric cognitive risk syndrome.³⁰ There may be a direct relationship between neuroticism, extraversion, conscientiousness and the risk of UI. Higher neuroticism is characterized by a higher vulnerability to stress and anxiety,¹¹ which may manifest in lower bladder control and urinary dysfunction.^{20,21} In contrast, being organized and having self-control are defining facets of conscientiousness, which may manifest in better bladder control and lower likelihood of UI. Furthermore, higher extraversion is characterized by higher energy, which may promote the maintenance of basic physiological functions, including bladder functioning and reduce the risk of UI. Indirect pathways are also likely to explain part of these associations. In particular, frailty could explain part of the association between neuroticism, extraversion, and conscientiousness and UI. Indeed, higher neuroticism is associated with a higher risk of frailty^{13,14} which is commonly accompanied by UI.⁶ In contrast, the lower frailty risk of higher extraversion and conscientiousness^{13,14} may manifest in lower risk of UI. Furthermore, the clinical and behavioral profiles of individuals higher in neuroticism, extraversion and conscientiousness may explain in part their association with risk of UI. Indeed, higher neuroticism is related to higher BMI,²⁵ which increases the risk of UI,⁹ whereas higher extraversion and conscientiousness are associated with lower BMI,²⁵ which may lead to lower likelihood of UI. In addition, higher neuroticism and lower conscientiousness are associated with a higher risk of diabetes and hypertension²⁶ and smoking,²⁷ which are also implicated in higher risk of UI.⁹

There are other factors that are likely to explain the association between personality and UI. For example, higher neuroticism and lower conscientiousness are related to worse brain health, including neuronal and glial cell damage,²⁴ which may alter the processing of signals from the bladder and increase the likelihood of UI. Cognitive function may also be a potential pathway that links personality to UI. Indeed, higher neuroticism and lower conscientiousness, and to a lesser extent lower extraversion, openness, and agreeableness, are associated with a higher risk of cognitive impairment and dementia,¹⁹ which are implicated in elevated risk of UI.³¹ These traits may also contribute to UI through biological factors. Higher neuroticism and lower conscientiousness, for example, are associated with higher inflammation,³² which in turn is related to overactive bladder.³³ Higher neuroticism, lower extraversion and lower conscientiousness are also associated with lower muscular strength, indexed by grip strength,³⁴ which has been related to higher likelihood of UI.³⁵ Finally, the observed associations may partly reflect the different coping styles associated with these personality traits. That is, higher neuroticism, lower extraversion and lower conscientiousness may be related to less efficient coping with UI.

Higher openness and agreeableness were associated with lower risk of concurrent UI and, to a lesser extent, lower risk of incident UI. The association between openness and incident UI was apparent in two out of three samples, and the association between agreeableness and incident UI observed in the meta-analysis was mainly driven by the significant association found in ELSA. This pattern is consistent with the mixed evidence for an association between these traits and other common geriatric syndromes. For example, openness and agreeableness have been related to a reduced risk of frailty in some studies,¹⁴ whereas no significant association was found in others.¹³ In addition, similar to the current associations with UI, the associations between openness and agreeableness and frailty had smaller effect sizes than neuroticism, extraversion, and conscientiousness.¹⁴

The present study adds to existing knowledge in several ways. First, this study contributes to research on the factors associated with the risk of UI⁹ by providing novel evidence for the role of enduring patterns of feeling, thinking, and behaving. UI may reflect not only a range of demographic, clinical, and behavioral factors, but also characteristic personality traits. In addition, the present research extends the literature on the link between personality and health in older adulthood^{14,17} by identifying an association with a significant and prevalent geriatric syndrome. This study also has practical implications. The observed robust and replicable associations suggest that personality assessment could help identify individuals at risk of UI. Personality traits can be easily and quickly assessed with short questionnaires, such as the MIDI or the short form of the Big Five Inventory 2,³⁶ or with slightly longer measures like the NEO Five-Factor Inventory.²² Such measures can provide a cost-effective method for gaining information on fundamental psychological traits relevant to the health and well-being of older adults. Our findings are also informative for prevention and treatment interventions, for example, by tailoring treatment (e.g., personalized medicine) to optimize healthcare strategies. Furthermore, some research suggests that interventions could be directed toward changing maladaptive personality traits,³⁷ which could ultimately reduce risk for complex geriatric syndromes, including UI.

The present study has several strengths, such as the first examination of the association between personality and concurrent and incident UI, the three large samples of middle-aged and older adults, the meta-analytic synthesis of results, the longitudinal follow-ups ranging from 8 to 20 years, and the inclusion of all five major dimensions of personality as well as demographic, clinical, and behavioral covariates. Of importance, the associations replicated across samples that used questions about UI with different time frames. There are also several limitations. Causal interpretations are not possible due to the observational design of the present study. Although personality predicts incident UI, it is also likely that UI may lead to personality change. Indeed, UI has been associated with increased functional limitations and depressive symptoms³ and poor health-related quality of life,¹ which may ultimately lead to higher neuroticism, lower extraversion and lower conscientiousness. Future research is needed to test such potential reciprocal relationships. Furthermore, data on stress and urge incontinence were only

available at baseline in the HRS. Therefore, it was impossible to examine the association between personality and different categories of concurrent and incident UI across the three samples, such as stress incontinence, urge incontinence, or overflow incontinence. Future studies may examine whether the link between personality traits and UI is moderated by the type of incontinence. Finally, the present study only examined broad personality domains. A facet-level approach may provide a more detailed picture of the association between personality and risk of UI.

5 | CONCLUSIONS

Despite these limitations, the present study provides replicable evidence for an association between personality traits and risk of UI: Higher neuroticism was associated with a higher risk of concurrent and incident UI, whereas higher extraversion, openness, agreeableness, and conscientiousness were related to lower risk of concurrent and incident UI.

AUTHOR CONTRIBUTION

Yannick Stephan: Conceptualization, Methodology, formal analysis, writing – original draft, writing-review & editing, visualization, supervision, project administration. **Angelina R. Sutin:** Conceptualization, writing –review & editing, visualization. **Antonio Terracciano:** Conceptualization, formal analysis, writing – original draft, writing-review & editing, visualization, supervision.

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CONFLICT OF INTEREST STATEMENT

None.

DATA AVAILABILITY STATEMENT

MIDUS data are publicly available at <http://midus.wisc.edu/index.php>. HRS data are publicly available at <https://hrs.isr.umich.edu/data-products>. ELSA data are publicly available at: <https://www.ukdataservice.ac.uk/>.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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