Personality and Headaches: Findings From Six Prospective Studies

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ABSTRACT

Objective: The present study examined the association between personality traits and concurrent and incident headaches.

Methods: Participants (n = 34,989), aged 16 to 107 years were from the Midlife in the United States study, the Midlife in Japan study, the Health and Retirement Study, the Wisconsin Longitudinal Study Graduate and Siblings samples, and the Longitudinal Internet Studies for the Social Sciences. Demographic factors, personality traits, and headaches were assessed at baseline. Headaches were assessed again 4 to almost 20 years later.

Results: Across the samples, higher neuroticism was related to a higher likelihood of concurrent (combined odd ratio = 1.41, 95% confidence interval [CI] = 1.28–1.55, $p < .001$) and incident (combined odd ratio = 1.28, 95% CI = 1.12–1.46, $p < .001$) headaches, whereas higher extraversion was associated with a lower likelihood of concurrent (combined odd ratio = 0.87, 95% CI = 0.84–0.89, $p < .001$) and incident (combined odd ratio = 0.90, 95% CI = 0.85–0.96, $p = .001$) headaches. Higher conscientiousness (combined odd ratio = 0.90, 95% CI = 0.86–0.94, $p < .001$) and openness (combined odd ratio = 0.95, 95% CI = 0.90–0.99, $p = .025$) were associated with a lower probability of reporting concurrent headaches. Agreeableness was unrelated to headaches. Sex was not a consistent moderator.

Conclusions: The present study provides robust evidence that neuroticism and introversion are risk factors for headaches in concurrent and prospective analyses across multiple cohorts.

Key words: personality, headaches, adulthood.

INTRODUCTION

Headaches, including migraines and tension-type headaches, are highly prevalent in adult populations (1,2) and are among the main cause of disability worldwide (3). In some cases, headaches are signs of a neurological disorder (4) and are predictive of several deleterious health-related outcomes, including stroke (5) and Alzheimer's disease and related dementias (6). There are significant individual differences in the susceptibility to experience headaches, and research on potential risk factors can improve knowledge on the etiology of headaches and inform prevention and treatment approaches. Past research indicates that biological, life-style, and environmental factors are related to risk of headaches (7–11). There is also evidence that personality traits are associated with reports of pain (12,13) and in particular headaches (14).

Among the five traits defined by the Five Factor Model of personality (15), also known as the big five, neuroticism has been associated consistently with a higher likelihood of headaches and migraines (14,16–19). The basic tendencies associated with this trait may explain part of this association. Neuroticism is defined by a tendency to be tense and experience intense and frequent emotional distress, which contribute to headaches (20). A behavioral pathway may also operate. Neuroticism is related to smoking, alcohol abuse, and sleeping difficulties, including bruxism (21–24), which are risk factors for headaches and migraines (7–10). Less consistent evidence has been found for an association between the other four traits and headaches. Lower extraversion level has been found among patients with headaches, including both migraines and medication-overuse headache, compared with a normative sample (25). Furthermore, patients with migraines were more conscientious compared with a normative sample, whereas patients with medication-overuse headaches scored higher on neuroticism and lower on openness, agreeableness, and conscientiousness (25). Others have found that extraversion was related to a lower likelihood of migraines among patients with bipolar disorders (19). Studies further reported a link between lower openness and the co-occurrence of migraines and depression, whereas no association was observed with extraversion, agreeableness, and conscientiousness (18). Finally, a longitudinal study found no association between the five traits and medication-overuse headache onset in a sample of patients with migraines (26).

BMI = body mass index, **HRS** = Health and Retirement Study, **LISS** = Longitudinal Internet Studies for the Social Sciences, **MIDJA** = Midlife in Japan survey, **MIDUS** = Midlife in the United States survey, **WLSG** = Wisconsin Longitudinal Study Graduate, **WLSS** = Wisconsin Longitudinal Study Sibling

SDC Supplemental Digital Content

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Most of the aforementioned previous studies have relied on small clinical samples, which could explain some of the inconsistent findings. Some studies have focused on one trait, such as neuroticism, and few have examined the full five factor model. No large-scale study on the association between all five major personality traits and headaches has been conducted yet. In addition, few longitudinal studies on the association between personality traits and incident headaches have been conducted. Given that headaches may influence concurrent personality ratings, prospective evidence among individuals free of headaches at baseline can provide more convincing evidence of personality as a risk factor for incident headaches. Concurrent and longitudinal associations also provide a test of whether the associations are dependent on concurrent states or whether the predictive power of personality is maintained over the years.

The present study examined the associations between personality traits and headaches across adulthood. In line with existing research (14,26), it was hypothesized that higher neuroticism would be related to a higher likelihood of concurrent and incident headaches. Furthermore, building on prior findings (25,26), a tentative hypothesis was made that higher extraversion, openness, agreeableness, and conscientiousness would be related to a lower likelihood of concurrent and incident headaches.

METHODS

Participants

Data were drawn from the Midlife in the United States (MIDUS) survey, the Midlife in Japan (MIDJA) survey, the Health and Retirement Study (HRS), the Wisconsin Longitudinal Study Graduate (WLSG) and Sibling (WLSS) samples, and the Longitudinal Internet Studies for the Social Sciences (LISS). These studies were selected because they included a big five personality measure and a measure of headaches at both baseline and a subsequent follow-up. Furthermore, these studies were included because they were freely available. Written consent was obtained from all participants in each sample. Descriptive statistics for the six samples are presented in Table 1. Attrition analyses are presented in Supplemental Digital Content, http://links.lww.com/PSYMED/A709.

The MIDUS is a sample of noninstitutionalized, English-speaking adults. The first (1994–1995, MIDUS I) and third (2013–2014, MIDUS III) waves were used in the present study. A total of 6023 participants aged from 20 to 75 years (52% women, mean [standard deviation, or SD] age = 46.81 [12.88] years) provided complete baseline demographic, personality, and headache data. From this sample, 2566 also provided headache data at follow-up. MIDUS data are publicly available at http://midus.wisc.edu/index.php.

The MIDJA is a parallel survey of the MIDUS conducted on randomly selected adults from the Tokyo metropolitan area. Data were drawn from the first (2008) and second (2012) waves. At baseline, complete demographic, personality, and headache data were obtained from 1004 participants aged from 30 to 79 years (51% women, mean [SD] age = 54.09 [14.01] years). Within this sample, follow-up data were obtained from 635 participants. MIDJA data are publicly available at http://midus.wisc.edu/index.php.

The HRS is a nationally representative longitudinal study of Americans older than 50 years. Baseline demographic, personality, and headache data were obtained from half of the sample in 2006 and from the other half in 2008. The two waves were combined, resulting in a baseline sample of 12,106 participants aged from 50 to 107 years (59% women, mean [SD] age = 68.51 [9.81] years). Of this sample, 7750 individuals provided follow-up headache data in the 2016 wave. HRS data are publicly available at http://hrsonline.isr.umich.edu/.

The WLS is a long-term study of a random sample of 10,317 men and women who graduated from Wisconsin high schools in 1957. The WLS sample is broadly representative of White, non-Hispanic American men and women who graduated from high school (WLSG). A total of 6673 participants aged from 50 to 56 years (54% women, mean [SD] age = 53.21 [0.63] years) provided complete baseline demographic, personality, and headache data in 1992 to 1993. Follow-up headache data were obtained from 4339 individuals in 2011. The WLS also includes selected siblings (WLSS) of some of the graduates. Baseline data were obtained in 1993 to 1994 from 3387 individuals aged from 29 to 79 years (53% women, mean [SD] age = 53.50 [7.36]). From this sample, 1961 individuals also provided follow-up headache data in 2011. A public use file of data is available at http://www.ssc.wisc.edu/wlsresearch/data/.

TABLE 1. Baseline Characteristics of the Samples

	MIDUS		MIDJA		HRS		WLSG		WLSS		LISS	
Variables	M or %	SD	M or %	SD	M or %	SD	M or %	SD	M or %	SD	M or %	SD
Age, y	46.81	12.88	54.09	14.01	68.51	9.81	53.21	0.63	53.50	7.36	45.98	15.66
Sex, % women	52	—	51	—	59	—	54	—	53	—	54	—
Race, % White	92	—	0	—	85	—	100	—	100	—	100	—
Education	6.87	2.47	4.48	2.08	12.82	2.97	13.71	2.30	13.78	2.54	3.61	1.64
Neuroticism	2.24	0.66	2.10	0.56	2.04	0.61	3.21	0.98	3.22	0.95	2.58	0.68
Extraversion	3.20	0.56	2.43	0.68	3.20	0.56	3.84	0.89	3.76	0.90	3.29	0.63
Openness	3.01	0.52	2.19	0.61	2.94	0.55	3.64	0.80	3.60	0.76	3.51	0.50
Agreeableness	3.49	0.49	2.64	0.63	3.53	0.47	4.75	0.74	4.69	0.74	3.91	0.49
Conscientiousness	3.42	0.44	2.61	0.55	3.36	0.48	4.87	0.68	4.78	0.71	3.73	0.52
Headaches, %	71	—	49	—	7	—	47	—	63	—	22	—
Incident headaches, %[a]	23		20		4		18		11		7	

MIDUS = Midlife in the United States survey; MIDJA = Midlife in Japan survey; HRS = Health and Retirement Study; WLSG = Wisconsin Longitudinal Study Graduate; WLSS = Wisconsin Longitudinal Study Sibling; LISS = Longitudinal Internet Studies for the Social Sciences; M = mean; SD = standard deviation.

MIDUS, n = 6023; MIDJA, n = 1004; HRS, n = 12,106; WLSG, n = 6673; WLSS, n = 3387; LISS, n = 5796.

[a] Individuals who reported headaches at baseline were excluded.

The LISS is a representative longitudinal sample of the Dutch population. A total of 5796 participants aged from 16 to 94 years (54% women, mean [SD] age = 45.98 [15.66] years) provided complete baseline personality, demographic, and headache data in 2007. Within this sample, 2182 individuals also provided follow-up headache data in 2017. More information on the LISS panel can be found at: www.lissdata.nl.

Measures

Personality

The Midlife Development Inventory (27) was used to assess the five personality traits in the MIDUS, MIDJA, and HRS. A 26-item version was used in the MIDJA and HRS, whereas a 25-item version was used in the MIDUS. Participants were asked to indicate how much adjectives described them on a scale ranging from 1 (*not at all*) to 4 (*a lot*). Examples adjectives are moody (neuroticism), active (extraversion), curious (openness), warm (agreeableness), and organized (conscientiousness). A 29-item version of the Big Five Inventory (28) was used in the WLSG and WLSS. Participants were asked to rate the extent to which they agreed with descriptive statements on a 6-point scale, ranging from 1 (*disagree strongly*) to 6 (*agree strongly*). Examples are "To what extent do you agree that you see yourself as someone who can be tense?" (neuroticism), "To what extent do you agree that you see yourself as someone who is talkative?" (extraversion), "To what extent do you agree that you see yourself as someone who has an active imagination?" (openness), "To what extent do you agree that you see yourself as someone who is generally trusting?" (agreeableness), and "To what extent do you agree that you see yourself as someone who is lazy at time?" (conscientiousness). The International Personality Item Pool (29) was used to measure personality in the LISS. Participants were asked to indicate how accurately 50 items describe them on a scale from 1 (*very inaccurate*) to 5 (*very accurate*). Example items are as follows: "worry about things" (neuroticism), "start conversations" (extraversion), "have a vivid imagination" (openness), "have a soft heart" (agreeableness), and "like order" (conscientiousness). Cronbach α values ranged from .51 to .87 across the traits and across the samples.

Headaches

In the MIDUS and MIDJA, the following question was used to assess headaches: "During the past 30 days, how often have you experienced headaches?" Participants answered on a scale from 1 ("almost everyday") to 6 ("not at all"). The answers "almost once a month," "2–3 times a month," "once a week," "2–3 times a week," and "almost everyday" were recoded as 1, and "not at all" was coded as 0. In the HRS, participants were asked "since we last talked to you, have you had persistent headaches?" Participants responded yes or no. The WLSG used the question: "In the past six months, have you had headaches?" Participants responded yes or no. In the WLSS, participants were asked to rate "How often have you had headaches in the past six months?" using a scale from 0 ("have not had") to 3 ("daily or more often"). Answers of "monthly or less often," "about once a week," and "daily or more often" were recoded to 1, and "have not had" was coded as 0. In the LISS, participants were asked, "Do you regularly suffer from headache?" Participants responded yes or no. In each study, the same question was used at both time points, except in the WLSS. At follow-up, individuals in the WLSS were asked to report whether they had headaches in the last 6 months on a yes/no scale.

Covariates

Age, sex, and education were included as covariates. Years of education was reported in the WLSG, WLSS, and HRS, whereas the MIDUS, MIDJA, and LISS used a scale ranging from 1 (no grade school) to 12 (doctoral-level degree), from 1 (eighth grade high school) to 8 (graduate school), and from 0 (not yet completed any education) to 7 (other), respectively. Race was included as a covariate in the MIDUS and HRS.

TABLE 2. Summary of Logistic Regression Analysis Predicting Baseline Headaches From Baseline Personality Traits

	MIDUS[a]	MIDJA[b]	HRS[a]	WLSG[b]	WLSS[b]	LISS[b]	Pooled Odds Ratio	Heterogeneity τ
Neuroticism	1.39*** (1.30–1.48)	1.45*** (1.26–1.68)	1.56*** (1.46–1.67)	1.21*** (1.15–1.27)	1.32*** (1.22–1.43)	1.56*** (1.46–1.67)	1.41*** (1.28–1.55)	0.11
Extraversion	0.85*** (0.80–0.90)	0.91 (0.80–1.04)	0.82*** (0.77–0.88)	0.91*** (0.86–0.95)	0.85*** (0.79–0.92)	0.87*** (0.81–0.93)	0.87*** (0.84–0.89)	0.02
Openness	0.87*** (0.82–0.92)	1.01 (0.88–1.16)	0.93* (0.86–0.99)	0.99 (0.95–1.04)	0.98 (0.89–1.09)	0.95 (0.89–1.01)	0.95* (0.90–0.99)	0.04
Agreeableness	0.96 (0.91–1.02)	0.94 (0.83–1.08)	0.94 (0.87–1.01)	0.90*** (0.86–0.95)	1.11* (1.01–1.22)	0.98 (0.91–1.05)	0.97 (0.91–1.02)	0.05
Conscientiousness	0.89*** (0.84–0.95)	0.93 (0.81–1.06)	0.81*** (0.76–0.87)	0.92*** (0.87–0.96)	0.89* (0.80–0.98)	0.95 (0.89–1.01)	0.90*** (0.86–0.94)	0.04

MIDUS = Midlife in the United States survey; MIDJA = Midlife in Japan survey; HRS = Health and Retirement Study; WLSG = Wisconsin Longitudinal Study Graduate; WLSS = Wisconsin Longitudinal Study Sibling; LISS = Longitudinal Internet Studies for the Social Sciences; M = mean; SD = standard deviation.

Data presented are odds ratios and 95% confidence intervals.

MIDUS, n = 6023; MIDJA, n = 1004; HRS, n = 12,106; WLSG, n = 6673; WLSS, n = 3387; LISS, n = 5796.

[a]Adjusted for age, sex, education, and race.

[b]Adjusted for age, sex, and education.

*$p < .05$.

**$p < .01$.

***$p < .001$.

Data Analysis

In each sample, logistic regression analysis was conducted to test whether personality traits were related to the likelihood of headaches at baseline. Age, sex, and education (and race in the MIDUS and HRS) were included as covariates. Personality traits were standardized and examined separately. Logistic regression analysis was also used to predict incident headaches at follow-up. In these analyses, individuals who reported headaches at baseline were excluded. Random-effects meta-analyses were used to combine the results from the six samples using the Comprehensive Meta-Analysis software. Participants with missing data were not included in these analyses.

Several sensitivity analyses were conducted. Headache medication was available in the MIDUS, MIDJA, and LISS and was included as a control variable in additional analyses. In the samples with continuous headaches scales, additional analyses tested whether personality was related to the frequency of headaches. Because the prevalence of headaches is higher in women than in men (30,31), we further examined personality by sex interactions to detect whether personality may contribute to the reported disparities in headaches. In Supplemental Analysis, physical inactivity, smoking, alcohol consumption, and body mass index (BMI) were included as additional covariates (Supplemental Digital Content, http://links.lww.com/PSYMED/A709).

RESULTS

Consistent with our hypothesis, the meta-analysis indicated that higher levels of neuroticism were related to a higher risk of headaches in the cross-sectional analyses (Table 2). Specifically, a 1-SD higher neuroticism level was related to a 20% to 60% higher likelihood of headaches, an association that was significant in each of the six samples (Table 2). Also consistent with the tentative hypothesis, the meta-analysis found that higher extraversion, conscientiousness, and openness were associated with a lower probability of headaches (Table 2). Compared with neuroticism, the effect sizes for the other traits were modest, with 1-SD higher scores on these traits associated with approximately 10% to 20% reduced risk of headaches. These associations were significant in five samples for extraversion (MIDUS, HRS, WLSG, WLSS, LISS), four samples for conscientiousness (MIDUS, HRS, WLSG, WLSS), and two samples for openness (MIDUS, HRS). The associations sometimes went in opposite direction for agreeableness, and the overall association was null in the meta-analysis. An additional analysis was conducted to test the hypothesis of a dose-response relationship between neuroticism and headaches. Neuroticism was categorized into quartiles in each sample. The results suggest a dose-response association between neuroticism and headache across the full distribution. A second analysis found that the overall pattern was unchanged when physical inactivity, smoking, alcohol, and BMI were controlled for in the analysis (Supplemental Analysis, http://links.lww.com/PSYMED/A709). Although there were some changes, the overall pattern of relationships remained the same when all traits were included simultaneously (Supplemental Analysis, http://links.lww.com/PSYMED/A709).

As hypothesized, higher neuroticism was also related to incident headaches in longitudinal analyses (Table 3). This association was observed in four of six samples (MIDUS, HRS, WLSG, LISS). For every SD higher neuroticism, the likelihood of incident headaches increased by 15% to 65% (Table 3). Consistent with the tentative hypothesis, the meta-analysis revealed that higher extraversion was related to a reduced risk of incident headaches (Table 3). A 1-SD higher extraversion was related to an almost 10% lower likelihood of incident headaches. Openness, agreeableness, and

TABLE 3. Summary of Logistic Regression Analysis Predicting Incident Headaches From Baseline Personality Traits

	MIDUS[a]	MIDJA[b]	HRS[a]	WLSG[b]	WLSS[b]	LISS[b]	Pooled Odds Ratio	Heterogeneity τ
Neuroticism	1.23* (1.03–1.47)	1.02 (0.77–1.36)	1.44*** (1.29–1.61)	1.16** (1.04–1.29)	1.14 (0.89–1.46)	1.65*** (1.38–1.98)	1.28*** (1.12–1.46)	0.13
Extraversion	0.91 (0.76–1.08)	0.86 (0.65–1.14)	0.89 (0.80–1.00)	0.92 (0.82–1.02)	0.96 (0.76–1.22)	0.87 (0.72–1.05)	0.90** (0.85–0.96)	0
Openness	0.95 (0.79–1.14)	0.99 (0.75–1.32)	0.90 (0.81–1.01)	1.09 (0.97–1.22)	1.03 (0.80–1.32)	1.08 (0.89–1.31)	1.00 (0.92–1.08)	0.05
Agreeableness	1.04 (0.86–1.26)	0.95 (0.72–1.26)	1.00 (0.90–1.10)	0.92 (0.82–1.03)	1.01 (0.79–1.29)	1.06 (0.87–1.29)	0.98 (0.93–1.05)	0
Conscientiousness	1.04 (0.87–1.25)	1.35* (1.01–1.81)	0.85** (0.76–0.95)	0.93 (0.84–1.04)	0.89 (0.70–1.14)	0.94 (0.78–1.13)	0.95 (0.86–1.05)	0.08

MIDUS = Midlife in the United States survey; MIDJA = Midlife in Japan survey; HRS = Health and Retirement Study; WLSG = Wisconsin Longitudinal Study Graduate; WLSS = Wisconsin Longitudinal Study Sibling; LISS = Longitudinal Internet Studies for the Social Sciences; M = mean; SD = standard deviation.

Data presented are odds ratios and 95% confidence intervals.

MIDUS, $n = 735$; MIDJA, $n = 337$; HRS, $n = 7195$; WLSG, $n = 2241$; WLSS, $n = 685$; LISS, $n = 1694$.

[a]Adjusted for age, sex, education, and race.

[b]Adjusted for age, sex, and education.

*$p < .05$.

**$p < .01$.

***$p < .001$.

conscientiousness were largely unrelated to incident headaches. The relationship between neuroticism and incident headaches was reduced to nonsignificance in the MIDUS and WLSG when physical inactivity, smoking, alcohol, and BMI were included as covariates (Supplemental Analysis, http://links.lww.com/PSYMED/A709); the association in HRS and LISS remained significant. The overall pattern of relationships remained the same when the five traits were included simultaneously, despite some changes (Supplemental Analysis, http://links.lww.com/PSYMED/A709).

Sensitivity Analysis

The sensitivity analyses supported the robustness of the main analyses. First, the pattern of associations remained unchanged when headache medication was included as a covariate in samples that had this information (MIDUS, MIDJA, LISS). Second, the pattern of association was similar to the primary analyses when a continuous rather than dichotomous measure of headaches frequency was used in the MIDUS, WLSS, and MIDJA. Higher neuroticism was related to a higher frequency of headaches at baseline in the three samples (β_{MIDUS} = 0.21, p < .001; β_{MIDJA} = 0.23, p < .001; β_{WLSS} = 0.18, p < .001), whereas higher extraversion (β_{MIDUS} = −0.10, p < .001; β_{MIDJA} = −0.04, p = .18; β_{WLSS} = −0.06, p < .001) and conscientiousness (β_{MIDUS} = −0.07, p < .001; β_{MIDJA} = −0.03, p = .38; β_{WLSS} = −0.04, p = .033) were associated with a lower frequency of headaches in both the MIDUS and the WLSS. Openness was related to a lower frequency of headaches in the MIDUS (β = −0.06, p < .001) but not in the WLSS (β_{WLSS} = −0.04, p = .05) and the MIDJA (β_{MIDJA} = 0.02, p = .54). The association between agreeableness and headaches was not significant in the three samples (β_{MIDUS} = −0.02, p = .11; β_{MIDJA} = −0.02, p = .54; β_{WLSS} = 0.02, p = .14). Third, there was little evidence that the association between personality and headaches was moderated by sex.

DISCUSSION

Based on a pooled analysis of six population-based samples that included up to 34,000 individuals, the present study found that higher neuroticism and lower extraversion were related to a higher likelihood of concurrent headaches and incident headaches over time. In addition, higher openness and conscientiousness were associated with a lower risk of concurrent headaches. The effect sizes were similar across samples that differed in age, country of origin (from the United States, the Netherlands, and Japan), and measures of personality and headaches. This study provides new evidence of an association between personality and incident headaches over the short and long terms. It extends existing cross-sectional research (14,25) by showing that the link between personality and headaches persists over follow-ups ranging in time from 4 to 20 years.

Consistent with previous research (14,16–19), neuroticism was related to concurrent headaches. This result complements recent findings of an association between this trait and persistent pain (13). The present study extends this cross-sectional evidence base by showing that higher neuroticism also increases the risk of incident headaches over time. The basic tendencies of this trait may explain part of these associations. Neuroticism is defined by a tendency to experience distress, anxiety, and negative emotions that are known to increase the likelihood of headaches (20). Furthermore, neuroticism is related to a range of headaches-related behaviors, including smoking, alcohol consumption, and physical inactivity (21,22,32). Furthermore, higher neuroticism is related to higher obesity risk (33), which contributes to headaches (34). The present study found that the link between neuroticism and concurrent and incident headaches was partially accounted by physical inactivity, smoking, alcohol, and BMI. There may also be other pathways that operate in this association. For example, individuals high in neuroticism experience more sleeping difficulties (23), which is related to a higher risk of headaches (10). Finally, the consistent association between neuroticism and headaches could be explained by shared genetic factors (35).

Consistent with our tentative hypothesis, higher extraversion and conscientiousness and, to a lesser extent, higher openness were related to a lower likelihood of headaches. This finding extends existing knowledge (26) and is consistent with a recent report of an association between extraversion and conscientiousness and a lower risk of persistent pain (13). Higher extraversion was also protective of incident headaches over time. Both higher extraversion and conscientiousness are related to lower stress (36) and better sleep quality (23) that are known to reduce the risk of headaches. Extraverted and conscientious individuals are also more physically active (32) and less likely to be obese (33). Physical activity and lower BMI are both related to a lower probability of headaches (34,37). Openness is also related to lower stress reactivity (36) and more frequent physical activity (32), which may contribute to a lower likelihood of headaches. This better emotional, behavioral, and health-related profile may contribute to the reduced probability of incident headaches of individuals higher on extraversion. Physical inactivity, smoking, alcohol, and BMI, however, only partially accounted for the relationship between personality traits and headaches. In contrast to the expectations, there was less evidence for a relation between agreeableness and the risk of headaches.

The present study could inform existing research on the association between personality and a range of health and cognitive outcomes. Indeed, it is likely that headaches could be an intermediate factor that links traits to these outcomes. For example, higher neuroticism and lower conscientiousness are related to a higher risk of dementia (38), and headaches have been found to predict incident dementia and Alzheimer's disease (6). Therefore, part of the risk of dementia associated with higher neuroticism and lower conscientiousness may manifest through headaches. In addition, emotionally stable, extraverted, and conscientious individuals may experience less limitations in their daily activities because they are less at risk of headaches.

The present study has several strengths, including longitudinal analyses, in addition to cross-sectional associations, of the association between personality and headaches in six large samples of middle-aged and older adults that was summarized with a meta-analysis. There are also several limitations to consider. The observational design of the present study prevents causal interpretations. Furthermore, information on the type of headaches individuals were suffering from, such as migraines and tension-type headaches, was not available. More research is needed to test whether the link between personality and headaches varies depending on type. Medication information was also missing in most samples. Furthermore, the questions were phrased differently across the samples, leading to differences in headaches prevalence. For example, the HRS asked about persistent headaches, whereas the MIDUS and MIDJA asked

participants about the frequency of headaches. A more detailed investigation of the personality-headaches association is needed using a facet-level analysis of this association. Specifically, neuroticism facets related to anxiety have been found to be more deleterious for some health outcomes than those related to worry and vulnerability (39). Based on these findings and on the link between stress and headaches, it is also likely that these anxiety/tension facets could be related to a higher risk of headaches. However, other facets play a major role for other health parameters (38,40). Future research should test which facet is more strongly related to headaches. The meta-analysis revealed that there was heterogeneity in the association between personality and concurrent and incident headaches. The HRS had a major influence on the pooled effect estimates because of its larger size. It is of note, however, that similar associations were seen across cohorts. The variations that were observed across studies could be explained by differences in how headaches and personality were assessed in each study, the different follow-up length, and cultural differences between samples.

Despite these limitations, the present study found replicable associations between personality and headaches. Higher neuroticism and lower extraversion were related consistently to a higher risk of headaches, both concurrently and over time. Furthermore, higher openness and conscientiousness were associated with a lower probability of concurrent headaches. Therefore, the identification of individuals at risk of developing headaches could be improved by personality assessments, particularly for neuroticism given its associations with other headache-related outcomes. These findings could also inform the tailoring of interventions to match the personality characteristics of individuals. Because of their propensity to experience stress and vulnerability to anxiety and other mental health conditions (41), a stress management intervention may be more beneficial for someone higher in neuroticism, whereas other interventions may be more effective for someone lower in this trait. Furthermore, interventions could be targeted toward directly changing maladaptive personality traits (42). Taken as a whole, the present study indicates that personality traits play a role in the vulnerability or resilience to headaches.

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