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# Personality and Motoric Cognitive Risk Syndrome

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## Abstract

**Objectives:** To examine whether five major personality traits are related to the motoric cognitive risk (MCR) syndrome, a pre-dementia syndrome characterized by cognitive complaints and slow gait speed.

**Design:** Cross-sectional

**Setting:** Health and Retirement Study (HRS) and the National Health and Aging Trends Survey (NHATS).

**Participants:** Dementia-free older adults aged from 65 to 107 years (N> 8,000).

**Measurements:** In both samples, participants provided data on personality, cognitive complaints and measures of gait speed, as well as on demographic factors, physical activity, depressive symptoms and body mass index (BMI).

**Results.—**Across the two samples and a meta-analysis, higher neuroticism was related to higher risk of MCR (Combined OR= 1.32; 95% CI=1.21–1.45; p<.001), whereas higher extraversion (Combined OR= .71; 95% CI=.65-.79; p<.001) and conscientiousness (Combined OR=.70; 95% CI=.62-.78; p<.001) were associated with a lower likelihood of MCR. Higher openness was also related to a lower risk of MCR in the HRS and the meta-analysis (Combined OR= .77; 95% CI= .70-.85; p<.001), whereas agreeableness was protective only in the HRS (OR= .83; 95% CI= .74-.92; p<.001). Additional analyses indicated that physical activity, depressive symptoms and BMI partially accounted for these associations.

**Conclusion.—**This study adds to existing research on the factors related to the risk of MCR by showing an association with personality traits. Personality assessment may help to identify

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**Author Contributions**: Yannick Stephan designed and conceptualized the study, analyzed the data, and drafted the manuscript for intellectual content. Antonio Terracciano conceptualized the study, analyzed the data, and drafted the manuscript for intellectual content. Angelina R. Sutin and Brice Canada interpreted the data and drafted the manuscript for intellectual content. All authors read and approved the final manuscript.

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individuals that may be targeted by interventions focused on reducing the risk of MCR, and ultimately of dementia.

**Keywords**

Personality; motoric cognitive risk; cognitive complaint; walking speed

The motoric cognitive risk (MCR), a predementia syndrome defined by cognitive complaints and slower walking speed[1,2,3], is receiving broad attention because MCR is associated with increased risk of developing cognitive impairment and dementia[2,4,5], as well as disability, falls, and mortality[5,6,7,8]. For example, MCR is associated with a two to threefold higher risk of incident dementia[2,4]. Several factors increase risk of MCR, including lower education, older age, cardiovascular risk factors such as obesity and stroke, Parkinson's disease, physical inactivity and depressive symptoms[3,9,10]. Furthermore, polygenic risk for obesity is related to MCR[11]. However, to our knowledge, no research has yet tested whether fundamental psychological dispositions, such as personality traits, are related to MCR.

Personality traits are the enduring pattern of thoughts, feelings and behaviors that characterize each person. The major personality traits described by the Five Factor Model (FFM)[12] are neuroticism (the propensity to experience negative emotions and distress), extraversion (the tendency to be outgoing and gregarious), openness (the propensity to be curious and imaginative), agreeableness (the tendency to be trusting and caring), and conscientiousness (the tendency to be organized and self-disciplined). There is replicable evidence for the predictive role of personality traits for health across the lifespan[13], including a range of factors implicated in MCR[3,9], such as depressive symptoms[14], physical inactivity[15,] and obesity[16]. Personality is also related to both mobility-related and cognitive outcomes. Higher neuroticism, low conscientiousness and extraversion, for example, are related to increases in frailty over time[17,18], and higher neuroticism and lower conscientiousness predict risk of incident falls[19]. Similarly, higher neuroticism, lower conscientiousness and openness are related to steeper cognitive decline[20,21], and higher risk of cognitive impairment and incident dementia[22,23,24]. Of particular relevance to this study, personality traits are related to the individual components of the MCR syndrome. Indeed, higher neuroticism predicts cognitive complaints[21,25] and steeper declines in gait speed over time[26]. In contrast, higher conscientiousness, extraversion, and openness are associated with fewer cognitive complaints[21,25] and slower decline in walking speed over time[26]. Agreeableness has been related to cognitive complaints[21] but not to gait speed[26]. However, no study has yet examined whether these traits relate to the simultaneous presence of cognitive complaints and slow gait, as defined by MCR.

Using two large samples of older adults, the present study examined the associations between personality traits and the MCR syndrome. It was hypothesized that high neuroticism would be related to higher risk of MCR, whereas high conscientiousness, extraversion and openness would be associated with lower risk of MCR. No link was expected with agreeableness. Additional analysis tested whether physical inactivity, depressive symptoms and BMI accounted for the association between personality and MCR in both samples.

# METHOD

## Study Sample

Participants were drawn from the Health and Retirement Study (HRS) and the National Health and Aging Trends Study (NHATS). The HRS is approved by the Institutional Review Board at the University of Michigan, and the NHATS is approved by the Institutional Review Board at the Johns Hopkins Bloomberg School of Public Health. Written informed consent was obtained from all participants in each study. Both the HRS and NHATS public use files used in this study qualify as anonymized, de-identified, freely available datasets and secondary data analysis using these files qualify for exempt IRB status. Descriptive statistics are in Table 1.

The HRS is a nationally representative longitudinal study of adults aged 50 years and older. In 2006, an enhanced face-to-face interview was implemented for a random half of the sample that included a psychosocial questionnaire and physical functioning tests. The other half of the sample was interviewed in 2008. Timed gait was obtained only among individuals aged 65 years and older. Data from the 2006 and 2008 waves were combined. Only participants with complete data on personality traits, demographic factors, gait speed and self-rated memory were included, resulting in a sample of 6,525 individuals (with outliers removed on gait speed). Consistent with existing criteria[3,4], individuals with dementia were excluded from the sample based upon validated methods in the HRS, using the modified Telephone Interview for Cognitive Status (TICSm)[27]. A 27-point composite score was computed from a test of immediate and delayed recall, a serial 7 subtraction test, and a backward counting test. In line with existing criteria[27,] a score of 6 or less defined dementia, leading to the exclusion of 225 participants. The final sample was composed of 6,300 participants aged from 65 to 107 years (57% women, Mean= 74.01, SD= 6.68). Attrition analysis revealed that participants in the final sample were younger (d= .66), more educated (d=1.09), more likely to be white, more extraverted (d= .14), open (d= .48), agreeable (d= .17), and conscientious (d=.50) than those who were excluded.

The NHATS is a nationally representative prospective cohort study of Medicare enrollees aged 65 years and older. Personality was obtained from two-thirds of the sample. Personality was first assessed in 2013 for one-third of the sample, and in 2014 for the second third. Data from both waves were combined. With outliers removed on gait speed, a total of 2,237 participants provided complete data on personality, gait speed, memory perception, and demographic factors. The criteria developed by the NHATS investigators were used to identify dementia status[28]. Participants were classified as having dementia if a doctor had diagnosed the participant with dementia or Alzheimer's disease, or if they reported a score of 2 or higher on the AD8 Dementia Screening Interview, or if they scored ≤1.5 SD below the mean on a cognitive tasks in at least two out of three domains: memory (immediate and delayed word recall), orientation (date, month, year, day of the week, President and Vice President) and executive function (clock drawing). Using these criteria, 154 individuals identified as having dementia were excluded, resulting in a final sample of 2,083 participants aged from 67 to 103 years (58% women, Mean= 78.48, SD= 7.06). Participants in the final

sample were younger (d= .80), more educated (d= .41), more agreeable (d= .22), open (d= .25) and conscientious (d= .30) than those who were excluded.

## Personality

The Midlife Development Inventory (MIDI)[29] was used to assess personality traits in both the HRS and the NHATS. A 26-item version was used in the HRS and a 10-item version was used in the NHATS. In both samples, participants were asked to indicate the extent to which adjectives that assessed neuroticism (e.g. nervous), extraversion (e.g. talkative), openness (e.g. creative), agreeableness (e.g. warm), and conscientiousness (e.g. organized) described themselves on a scale ranging from 1 (*not at all*) to 4 (*a lot*).

## Motoric Cognitive Risk Syndrome

The MCR syndrome is defined as the presence of both cognitive complaints and slow gait among individuals without dementia and immobility[3,4]. Past research has specified criteria for the diagnosis of MCR in both the HRS and the NHATS[7]. In the HRS, two questions were used to elicit cognitive complaints: «How would you rate your memory at the present time? Would you say it is excellent, very good, good, fair, or poor?» and «Compared with the previous interview, would you say your memory is better now, about the same, or worse than it was then?». In line with existing criteria[7], a response of fair or poor for the first item or of worse for the second item was coded as indicative of cognitive complaints. These two questions were also used in the NHATS in addition to a third one: « In the last month, how often did your memory problems interfere with your daily activities? Would you say everyday, most days, some days, rarely or never?». Following past research[7], a response of everyday, most days, and some days indicated cognitive complaints. Gait speed was measured using a 2.5 meters course in the HRS and a 3-m test in the NHATS. The best of two trials was used in the present study. In each sample, the distance (in meters) was divided by the time (in seconds). The following cut-off values defined by recent research[7] were used to categorize slow gait: men < 75 years= 0.61 (HRS) and 0.69 (NHATS) m/s, men ≥75 years= 0.48(HRS) and 0.52 (NHATS) m/s, women < 75 years= 0.54 (HRS) and 0.59 (NHATS) m/s, and women ≥ 75 years= 0.42 (HRS) and 0.40 (NHATS) m/s. Seven individuals in the HRS and one individual in the NHATS were removed because they had values 3 standard deviations above or below the mean.

## Covariates

Age, sex, education and race were controlled for in the two samples. Education was reported in years in the HRS and measured on a scale ranging from 1 (*No schooling completed*) to 9 (*Master's professional or doctoral degree*) in the NHATS. A 8-item version of the Centers for Epidemiologic Research Depression (CES-D) scale was used in the HRS[30]. The sum of participants' report of eight specific symptoms for much of the past week was used to create a total depressive symptom score. In the NHATS, the Patient Health Questionnaire (PHQ)-2 was used[31]. Participants were asked to report how often they had little interest or pleasure in doing things, and how often they felt down and depressed or hopeless during the last month, using a scale from 1 (not at all) to 4 (nearly every day). BMI was calculated as $kg/m^2$, from measured height and weight in the HRS and from reported height and weight in the NHATS. Two items were used in the HRS to assess physical inactivity that asked how frequently

participants participated in vigorous and moderate activities using a scale ranging from 1 (more than once a week) to 4 (hardly ever or never). In the NHATS, individuals were asked to report whether they ever spend time on vigorous activities in the last month (yes/no). Cognitive performance was the total TICSm score in the HRS and a global cognitive score in the NHATS that was the sum of performance on memory, orientation and executive function tests.

### Statistical analysis

In both the HRS and the NHATS, logistic regression analysis was conducted to test whether personality traits were related to the likelihood of MCR syndrome. Age, sex, education and race were controlled for in each sample. Follow-up analysis included physical inactivity, depressive symptoms and BMI as additional covariates. A second follow-up analysis controlled for cognitive performance. Personality traits were standardized and examined separately. A random-effect meta-analysis using the Comprehensive Meta-Analysis software combined the estimates from both samples.

In sensitivity analyses, individuals with clinical levels on only one of the two components of the MCR (slow gait or cognitive complaints) were excluded from the analysis. In addition, the same analysis was conducted excluding individuals with cognitive impairment not dementia.

## RESULTS

As hypothesized, higher neuroticism was related to higher likelihood of MCR whereas higher extraversion and conscientiousness were associated with a lower probability of MCR syndrome in both the HRS and the NHATS (see Table 2, Model 1). Also consistent with the hypothesis, higher openness was related to a lower likelihood of MCR in the HRS. Unexpectedly, an association was found between a higher agreeableness and lower likelihood of the syndrome in the HRS. Specifically, the results suggested that a one SD higher neuroticism was related to 21–36% higher risk of MCR respectively in the NHATS and the HRS. In contrast, for every SD increase in extraversion and conscientiousness, the likelihood of MCR decreased by 20–30% and 25–30% respectively in the NHATS and the HRS. A one SD higher score on openness and agreeableness was related to a 25% and 20% lower likelihood of MCR, respectively, in the HRS (see Table 2). The meta-analysis confirmed the overall pattern, except for agreeableness, which was not significantly related to MCR (see Table 2).

The link between neuroticism, extraversion, openness, agreeableness, and conscientiousness was attenuated in the HRS when depressive symptoms, physical inactivity and BMI were included in the model. In the NHATS, the association between extraversion and MCR was reduced but persisted, whereas the associations with neuroticism and conscientiousness were reduced to non-significance (Table 2, Model 2). When both samples were combined, the meta-analysis revealed that the associations between neuroticism, extraversion, openness and conscientiousness persisted while including depressive symptoms, physical activity and BMI (Table 2).

Sensitivity analysis revealed that the overall pattern of associations remained unchanged when individuals with clinical levels on only one of the two components of the MCR were excluded. The only exception was the emergence of a significant contribution of openness on the risk of MCR in the NHATS (Odds Ratio : 0.73, 95%CI : 0.59–0.90, p< .01). The pattern of associations was also similar when excluding participants with cognitive impairment not dementia, with the exception of a nonsignificant association between neuroticism and MCR in the NHATS (Odds Ratio : 1.19, 95%CI : 0.97–1.46, p=.10). Additional analyses also adjusted for performance on cognitive tests. The association between personality traits and MCR was reduced but remained significant in the HRS. In the NHATS, the link between neuroticism and MCR became not significant (Odds Ratio: 1.21, 95%CI : 1.00–1.47, p=.05).

## DISCUSSION

Based upon two large samples of older adults, the present study revealed that personality is related to the MCR syndrome. Consistent with the hypothesis, results from both samples and a meta-analysis revealed that higher neuroticism was related to higher likelihood of MCR, whereas high extraversion and conscientiousness were associated with lower risk, controlling for demographic factors. Higher openness was related to lower risk of MCR in the HRS and in the meta-analysis. An unexpected association was found between higher agreeableness and a lower probability of MCR in the HRS, but this link was not significant when estimates from the two samples were combined in the meta-analysis. This study adds to existing research on the factors related to the risk of MCR[11] by showing for the first time an association with personality traits.

Neuroticism, extraversion, and conscientiousness were the most consistent personality correlates of MCR, as indicated by their replicable association with the syndrome across the two samples. These traits are related to several behavioral, psychological and health related factors implicated in the likelihood of MCR. In particular, high neuroticism, low extraversion, and low conscientiousness are associated with higher depressive symptoms[14], lower physical activity[15], and obesity[16] that increase the risk of MCR[3,9,10]. In line with these studies, depressive symptoms, physical activity, and BMI partially accounted for the link between these traits and MCR, suggesting that these factors may act as mediators of this association.

Furthermore, high neuroticism may increase the likelihood of MCR syndrome because of its association with higher stress reactivity[32]. In contrast, high extraversion, openness, agreeableness and conscientiousness are related to lower stressor-related affect[32], which may lower the risk of MCR. Personality may also relate to MCR syndrome through biological mechanisms. Indeed, higher extraversion, openness, conscientiousness and low neuroticism are related to lower risk of physiological dysfunction[33] and better cardiovascular fitness[34], that may benefit both gait speed and cognition[35,36], resulting in lower MCR.

The present study is the first to identify an association between personality and the risk of MCR among older adults. Therefore, it adds to existing knowledge on the biological, behavioral and health-related factors related to this syndrome[5]. Furthermore, these findings

extend existing research on the link between personality and dementia. Indeed, higher neuroticism, and lower conscientiousness, openness and agreeableness are related to higher risk of Alzheimer's disease and related dementias[22,23]. Given that MCR is a significant pre-dementia syndrome[4], it could be an intermediate manifestation of the risk of dementia associated with these traits. Furthermore, MCR is related to higher risk of falls[6], and as such, it could mediate the association between higher neuroticism and lower conscientiousness and the risk of incident falls[19].

The strengths of the present study include the examination of the association between personality traits and MCR, using two large samples of older adults, comprehensive assessments of personality, and established criteria for MCR. However, there are also limitations, such as the cross-sectional design. The present study focused on personality as a predictor of MCR, but reciprocal associations may exist, such that MCR may be related to personality changes over time. As for clinical dementia[37], it is plausible that MCR would lead to maladaptive personality changes. Further research using longitudinal designs are needed to test for the reciprocal associations between personality and incident MCR. In addition, brief personality measures are used in the two samples. Future research is needed to explore whether specific personality facets are related to MCR. Furthermore, depressive symptoms were assessed using different instruments assessing different features of depression. In the HRS, depressive symptoms were computed on the basis of a report of symptoms over one week whereas the PHQ-2 asked only about anhedonia and quality of mood over the last month. Furthermore, participants included in the study had relatively more favorable personality profiles than those who were excluded because of a dementia diagnosis. It is likely that these participants were less apathetic, with intact initiative or motivation to complete the study. Although participants with dementia were excluded from the analysis, some individuals were characterized by cognitive impairment, which may be associated with their self-report of personality traits[38, 39]. Our sensitivity analyses indicated that the associations were similar when participants with mild cognitive impairments were excluded from the analyses. This pattern suggests that the results are not only due to the presence of cognitive impairments. Furthermore, a 36-year longitudinal study based on self-report ratings found no personality changes in the preclinical phase of dementia[40], suggesting that personality changes become evident during the prodromal and clinical phases of dementia[37,38,41]. However, research based on observer rating of neuropsychiatric symptoms have found that these symptoms (also known as behavioral and psychological symptoms of dementia and the related mild behavioral impairment) may precede cognitive symptoms in some individuals[42, 43]. To better understand the relation between personality traits and behavioral symptoms in the early phases leading to dementia, future longitudinal research should include both self-reports and observers' ratings of personality traits and behavioral symptoms as there may be differences across what individuals self-report versus what informants observe.

Despite these limitations, the present study found that personality is related to MCR syndrome. High neuroticism was related to higher probability of MCR, whereas high extraversion, openness, agreeableness and conscientiousness were associated with a reduced likelihood of MCR among individuals without dementia. Therefore, this study contributes to a better understanding of risk for MCR. Indeed, personality assessment may help to identify

individuals that may be targeted by interventions focused on reducing the risk of MCR, and ultimately of dementia.

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**Table 1.**

Characteristics of the Samples

| | HRS | | NHATS | |
|---|---|---|---|---|
| **Variables** | ***M/%*** | ***SD*** | ***M/%*** | ***SD*** |
| Age | 74.01 | 6.68 | 78.48 | 7.06 |
| Sex (% women) | 57% | - | 58% | - |
| Race (% White) | 89% | - | 76% | - |
| Education | 12.77 | 2.82 | 5.47 | 2.22 |
| BMI[a] | 28.69 | 5.54 | 27.52 | 5.47 |
| Physical inactivity[a] | 2.63 | 1.06 | 58% | - |
| Depressive symptoms | 1.18 | 1.73 | 1.39 | 0.60 |
| Cognition | 15.20 | 3.72 | 19.35 | 4.42 |
| Neuroticism | 1.98 | 0.68 | 2.19 | 0.83 |
| Extraversion | 3.22 | 0.53 | 3.17 | 0.73 |
| Openness | 2.92 | 0.54 | 2.88 | 0.81 |
| Agreeableness | 3.54 | 0.46 | 3.61 | 0.49 |
| Conscientiousness | 3.36 | 0.46 | 3.28 | 0.68 |
| Cognitive complaint (%) | 41% | - | 32% | - |
| Gait speed (m/s) | 0.83 | 0.29 | 0.80 | 0.26 |
| Motoric Cognitive Risk (%) | 6% | - | 5% | - |

*Note*. HRS: N= 6300; NHATS: N= 2083

[a]Due to missing data, N*s* differ for BMI, physical activity, depressive symptoms, and cognition

See method section for differences in measures used in the two samples

**Table 2.**

Summary of Logistic Regression Predicting Motoric Cognitive Risk Syndrome from Personality Traits

| | HRS | | NHATS | | Meta-Analysis | |
|---|---|---|---|---|---|---|
| | Model 1[a] | Model 2[b] | Model 1[c] | Model 2[d] | Model 1 | Model 2 |
| **Predictors** | **Odds ratio (95%CI)** | **Odds ratio (95%CI)** | **Odds ratio (95%CI)** | **Odds ratio (95%CI)** | **Odds ratio (95%CI)** | **Odds ratio (95%CI)** |
| Neuroticism | 1.36 (1.22–1.51)*** | 1.15(1.01–1.29)* | 1.21(1.00–1.47)* | 1.12(0.91–1.38) | 1.32 (1.21–1.45)*** | 1.14(1.03–1.27)* |
| Extraversion | .69 (.62-.76)*** | .77(.69-.86)*** | .79 (.66-.95)* | .80(.66-.97)* | .71 (.65-.79)*** | .78(.71-.86)*** |
| Openness | .74(.66-.82)*** | .79(.70-.88)*** | .85(.70–1.03) | .88(.72–1.08) | .77(.70-.85)*** | .81(.73-.90)*** |
| Agreeableness | .83(.74-.92)*** | .86(.77-.97)* | 1.04 (.86–1.27) | 1.07(.87–1.31) | .92(.74-.1.14) | .94(.76–1.17) |
| Conscientiousness | .67(.60-.74)*** | .77(.69-.86)*** | .76(.63-.91)** | .84(.69–1.01) | .70(.62-.78)*** | .79(.72-.87)*** |

Note.

*p<.05,

**p<.01,

***p< .001.

Model 1 is the association between each trait and motoric cognitive risk syndrome controlling for age, sex, education, and race. Model 2 is Model 1 plus the inclusion of BMI, physical activity, and depressive symptoms as additional covariates.

[a]N= 6,300,

[b]N= 5,955,

[c]N= 2,083,

[d]N= 2,039