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Review

Personality traits and incidence of pre-dementia conditions: A systematic review of longitudinal studies with meta-analysis

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ABSTRACT

Personality refers to relatively stable patterns of thoughts and behaviors. The objective of this study is to investigate whether FFM personality traits are associated with the risk of developing pre-dementia conditions. A systematic search was conducted using keywords and MeSH terms in three databases. Random-effects meta-analyses were performed separately for studies reporting Hazard Ratios and Odds Ratios. Subgroup analyses by follow-up duration and sex were used to explore heterogeneity, also were run a meta-regression using time as slope. 13 studies were included in the review and 9 in the meta-analysis. Participants' mean age ranged from 45.6 to 81.3 years; most samples were predominantly female. Follow-up ranged from 1.5 to 12 years. Neuroticism was associated with higher incidence of pre-dementia conditions (HR = 1.08, 95% CI: 1.02–1.15; $I^2 = 81.3$), while conscientiousness and openness show an inverse association (HR = 0.92, 95% CI: 0.84–0.99; $I^2 = 94.5$; and HR = 0.97, 95% CI: 0.94–0.99; $I^2 = 10.3$, respectively). No significant associations were found for extraversion and agreeableness. Subgroup analyses reduced heterogeneity for neuroticism and confirmed its associations in studies with 6 or more years of follow-up. Meta-regression showed a significant trend suggesting that the length of follow-up relates to how personality traits track with risk profiles for these conditions over time. In conclusion, higher neuroticism is associated an increased incidence of pre-dementia conditions, whereas openness and consciousness are linked to lower risk. Despite substantial heterogeneity, these findings suggest that personality traits might represent a complementary factor to consider in future risk stratification frameworks.

1. Introduction

The aging population is a worldwide phenomenon experienced mostly by developed and developing countries (Juni, 2015). This phenomenon will have serious costs on the healthcare system, since aging is often associated with many medical conditions that have an impact on the physical and psychosocial spheres (Lim et al., 2017). One of the main causes of disability among the elderly is dementia: according to the World Health Organization in 2021 Alzheimer's disease and other forms of dementia represented the 7th cause of death and almost 2 million people dying from this condition (WHO, 2024). The number of people with dementia is constantly increasing and it is estimated that in 2050 the number of people with some kind of dementia will be around 153 million (GBD 2019 Dementia Forecasting Collaborators, 2022).

It is necessary to study and identify the main risk factors of these conditions in order to prevent and reduce the incidence of dementia. In a recent report by the Lancet Standing Commission on Dementia (Livingston et al., 2024) 14 modifiable risk factors associated with the development of dementia were identified. Most of these are related to lifestyle (e.g. physical inactivity, smoking, excessive alcohol consumption etc.) or to the psychosocial sphere (e.g. depression, infrequent social contact). All these behaviors may be influenced by personality factors.

Personality is commonly defined as an enduring set of traits and behavioral styles that reflect an individual's characteristic patterns of thinking, feeling, and acting. These traits represent dispositional tendencies and distinguish the individual from what is considered typical or normative within their society (Bergner, 2020). One of the most well-known models in the field of personality is the Five Factor Model (FFM, McCrea & John, 1992) which conceptualize personality as a hierarchical organization based on five dimensions: i) *Openness* — the tendency to be creative, curious, sensitive to aesthetics, open to new ideas and experiences; ii) *Conscientiousness* — the tendency to be

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persistent, organized, goal-directed, and to show self-control and self-discipline; iii) *Extraversion* — the tendency to be assertive and social, and to experience positive affect and seek excitement; iv) *Agreeableness* — the tendency to be altruistic, trusting, modest, and compliant; and, v) *Neuroticism* — the tendency to be emotionally unstable, and to experience negative emotions such as anger, stress, anxiety, and depression.

These personality traits, also known as the Big Five, not only account for various aspects of human behavior and are linked to both health-promoting and risk-related behaviors (Allen et al., 2017; Lui et al., 2022; Diop et al., 2021), but also seem to be associated with mental health outcomes. Specifically, some studies suggest that *Openness* and *Extraversion* are negatively associated with symptoms of anxiety and depression. Furthermore, *Extraversion*, *Conscientiousness*, and *Agreeableness* appear to be negatively related to social dysfunction and anhedonia. In contrast, *Neuroticism* has been suggested to be positively associated with all of these conditions (Kang et al., 2023). Beyond these mental health outcomes, recent large-scale epidemiological evidence found that Big Five traits also exhibit significant transdiagnostic associations with a wide range of neurological disorders on a population scale (Kang et al., 2024). This suggest that personality profiles may reflect broader systemic vulnerabilities within brain aging, providing rational for investigate their role in neurocognitive pathways.

Some studies have examined the relationship between personality traits and cognitive decline, such as the association between *Neuroticism* with mild cognitive impairment (MCI) and dementia (Troisi et al., 2024), the link between *Agreeableness* and *Neuroticism* and worse cognitive health (Maldonato et al., 2017), or the effect of higher *Openness* on cognitive functioning (Montoliu et al., 2023). Personality traits have also been linked to the risk of dementia in a systematic review, which hypothesized that some aspects of personality could play a role in the process of cognitive decline (Aschwanden et al., 2021).

Dementia is often preceded by some preclinical condition characterized by the presence or absence of cognitive symptoms. Modern research frameworks conceptualize this progression as a continuous biological process, where clinical manifestation emerges only after years of silent neuropathological changes (Sperling et al., 2011; Jack Jr et al., 2018). The initial stage in the process of cognitive decline often begins with conditions that do not yet meet the criteria for objective cognitive impairment. The most common of these is Subjective Cognitive Decline (SCD), which is characterized by a self-perceived, persistent decline in cognitive functioning relative to a previously normal level, despite normal performance on standardized cognitive assessments and in the absence of an acute medical event (Jessen et al., 2014). Within this construct, subjective memory complaints are the most frequently reported symptoms, reflecting an individual's perception of worsening memory performance despite results remaining within the clinical range for their age and education (Cappa et al., 2024). SCD may be reversible, remain stable over time, or progress to more severe cognitive impairment. Individuals with SCD are considered to be at increased risk of developing various forms of dementia (Jessen et al., 2020). Another well-known pre-dementia condition is Motoric Cognitive Risk (MCR) syndrome, which is the presence of subjective cognitive complaints in the absence of objective cognitive impairment, accompanied by slow gait speed not attributable to a physical impairment, and preserved activities of daily living. Persons with MCR are at a significantly increased risk of developing various forms of dementia (Meiner et al., 2020; Verghese et al., 2013). Regarding the pre-dementia conditions with cognitive symptoms, the most prominent is MCI which is characterized by concerns regarding change in cognition and objective impairment in one or more cognitive domains, while independence in functional abilities is preserved (Albert et al., 2011). A diagnosis of MCI represents a risk factor for developing a form of dementia; however, not all individuals with MCI necessarily progress. Some may remain cognitively stable over time, and a subset may even revert to normal cognitive functioning (Petersen, 2011, McGirr et al., 2022). A related but broader construct is Cognitive Impairment Not Dementia (CIND). While the two terms are often compared, they differ in their evaluative approach: MCI is primarily a clinical diagnosis representing a symptomatic pre-dementia stage (Langa & Levine, 2014; Bradfield, 2023), whereas CIND is an epidemiological and performance-based construct (Graham et al., 1997; Tuokko & Frerichs, 2000). CIND identifies individuals with poor cognitive function based on standardized tasks following below established psychometric thresholds, regardless of the presence of subjective complaints. Consequently, CIND acts as an umbrella term that encompasses MCI as a subgroup, but also includes individuals with cognitive deficits stemming from a wider array of etiologies, and those who may show slight functional limitations (Chertkow et al., 2007; Langa & Levine, 2014).

Since personality has such an impact on the behaviors and lifestyles of individuals, it is reasonable to assume that it could also affect the quality of aging, mediated by the impact that personality traits exert on the main recognized risk factors for cognitive decline and dementia. While the relationship between personality traits and dementia is well-established, existing evidence has largely focused on clinical endpoints (Aschwanden et al., 2021; Beck et al., 2024; Troisi et al., 2024), with comparatively little attention to the earlier, non-clinical stages of cognitive decline. Shifting the focus to pre-dementia is a clinical necessity: unlike the irreversible nature of dementia, conditions such as SCD, MCR, and MCI/CIND represent a critical window of opportunity, as they are characterized by the preservation of autonomy and potential reversibility (Arruda et al., 2025; Hou et al., 2025; Jessen et al., 2020; McDowell et al., 2025; Salemme et al., 2025; Xiang et al., 2022). Identifying stable personality factors that predict the entry into this continuum might provide helpful insights for risk stratification and the development of personalized prevention strategies. This meta-analysis aims to fill this gap in the literature, as evidence remain weak due to the predominant focus of previous research on late-stage dementia. Consequently, the aim of this paper is to present the results of a systematic review and meta-analysis examining the association between the five personality traits of the FFM and the incidence of the aforementioned pre-dementia conditions.

2. Methods

This review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The protocol of this review was not pre-registered.

2.1. Eligibility criteria and selection process

We included studies if they met the following criteria:

(i) involved healthy adult participants;
(ii) included a baseline assessment of at least one of the Big Five personality traits;
(iii) reported follow-up measurements of at least one pre-dementia condition, identified through standardized (e.g., MCI, CIND, MCR, or SCD) outcome definitions assessed with validated tools;
(iv) utilized cohort studies, population-based, or longitudinal studies including open and closed cohorts, with a mean follow-up period of at least one year.

Studies were excluded if they included participants with any pre-dementia condition, psychiatric disorder, dementia, or other neurological conditions at baseline. Additional exclusion criteria were: studies focusing solely on the onset of dementia, case-control studies, cross-sectional designs, systematic reviews or meta-analyses, and studies assessing personality using a theoretical model other than the Big Five.

Duplicates were removed prior to screening. Title, abstract, and full-text screening were conducted independently by two reviewers, with an inter-rater agreement of Cohen's $k = 0.85$. Any discrepancies were discussed and resolved through consensus within the larger research team.

All records retrieved from each database were managed in Rayyan (Ouzzani et al., 2016). The selection process is shown in the PRISMA Flow Chart (Fig. 1).

2.2. Search strategy

The final search was conducted on August 5th, 2024, using the following databases: PubMed, Scopus and Web of Science; only articles published in peer-reviewed journals were selected. The literature search was performed using keywords in the title and abstract within each database. An additional search using Medical Subject Headings (MeSH) was performed exclusively in PubMed (the search string and MeSH terms are provided in the supplementary materials). Some records were also identified through snowball sampling. Grey literature was not included. No time restrictions were applied to the search, which was limited to academic publications written in English or Italian.

2.3. Exposure

Exposure was defined as the scores obtained on the five personality dimensions assessed using self-report that measure the FFM: *Openness*, *Conscientiousness*, *Extraversion*, *Agreeableness*, and *Neuroticism*.

2.4. Outcomes

Primary outcomes were Mild Cognitive Impairment (MCI) and Cognitive Impairment Not Dementia (CIND) which were analysed jointly due to the substantial similarity between these cognitive conditions. Both were assessed using a variety of tools (Table S1).

Secondary outcomes were Motoric Cognitive Risk Syndrome (MCR) and Subjective Cognitive Decline (SCD), also assessed using several tools (Table S1).

2.5. Data collection

For each study included in this review, we extracted the following: study identification, year of publication, country where study was conducted, sample observed, subjects lost at follow-up, mean age of participants and relative Standard Deviation (±SD), educational level in years (mean and ± SD), sex distribution, prevalence of race/ethnicity, tools used to assess personality and outcomes, type of outcome (MCI, CIND, MCR, or SCD), tools used to evaluate non-cognitive conditions, mean of follow-up in years (±SD), and the range of follow-up time. Besides, we collected data on the reported results including the type of association measure (e.g. Hazard Ratio, Odds Ratio, or β coefficients) and the effect size for each outcome with 95% CIs, and relative *p*-values. We extracted effect sizes from adjusted estimates that accounted for all reported confounding factors. Where adjusted estimates were unavailable, studies were relegated to the narrative synthesis rather than meta-analysis. In cases where studies reported multiple follow-up assessments, the most recent one (i.e., the longest duration) was selected for inclusion in the meta-analysis. This decision is based on the rationale that cognitive decline is a time-dependent process. Longer follow-up periods are more likely to capture the actual incidence of these conditions and provide a more reliable estimate of the long-term predictive value of personality traits.

2.6. Quality assessment

The quality assessment was performed using the JBI Checklist for Cohort Studies by two independent reviewers (M.M. & S.C.); any disagreements were resolved through consensus.

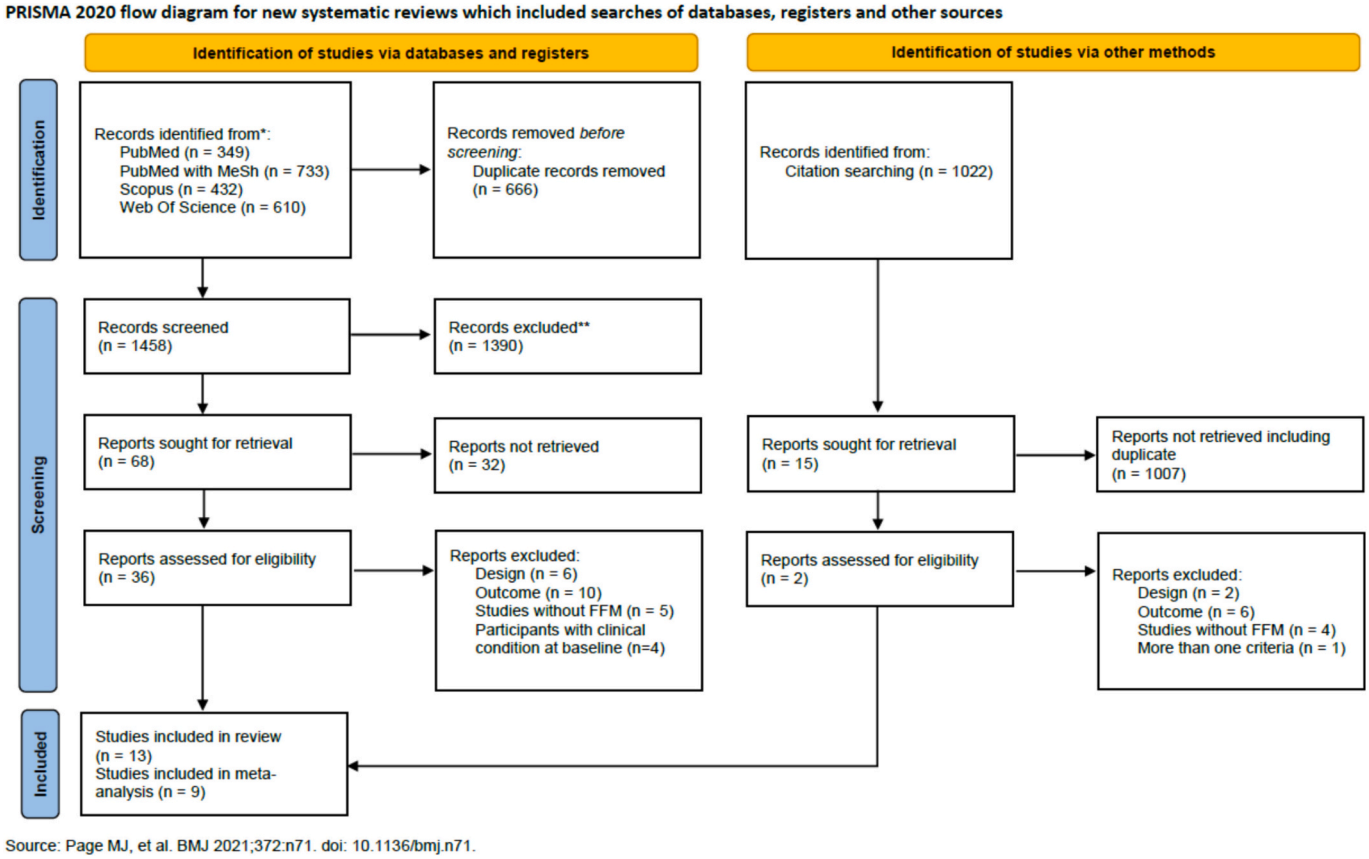

Fig. 1. PRISMA Flow Chart of selection process.

2.7. Synthesis of results and statistical analysis

Separate random-effects meta-analyses using the restricted maximum likelihood method were conducted for studies reporting adjusted Odds Ratio (OR) and adjusted Hazard Ratio (HR) as effect sizes, stratified by each of the five personality traits. Heterogeneity was evaluated using the H-squared (H^2) and I-squared (I^2) statistics. According to Higgins and Thompson (2002), I-squared values greater than 30% were considered indicative of substantial heterogeneity. To explore potential sources of heterogeneity, meta-regression analyses were conducted using follow-up duration as a predictor, and moderation analyses were performed for sex and follow-up duration (grouped in 1 to 5 years and 6 or more years). Furthermore, a cumulative meta-analysis was conducted based on follow-up duration. Egger's test was used to assess small-study effects, and potential publication bias was further examined using funnel plots and the trim-and-fill method. All analyses were performed using STATA version 18 (StataCorp, 2023) and the metafor package in R (Viechtbauer, 2010).

Studies that were not included in the meta-analysis were analysed qualitatively and are presented in this review through a narrative synthesis.

3. Results

A total of 1458 records were screened after deduplication, of which 1390 were excluded based on title screening. Of the 68 reports sought for retrieval, 36 were successfully retrieved and assessed for eligibility. Following this assessment, 25 reports were excluded for specific reasons (e.g. cross-sectional design, lack of FFM). Thus, 11 studies met the inclusion criteria. Subsequently, 1022 records were identified through snowballing (backward citation tracking) from the reference lists of the 36 studies retrieved from databases and assessed for eligibility. Of these, 15 reports were sought for retrieval and assessed, resulting in the inclusion of 2 additional studies. This brought the total to 13 included studies (comprising a total of 31,322 participants), 9 of which met the criteria for meta-analysis (see Fig. 1). Although Wilson et al. (2007) reported HRs, these were unadjusted; consequently, the study was limited to the narrative synthesis.

The included studies were predominantly conducted in the United States (Wilson et al., 2007; Hock et al., 2014; Luchetti et al., 2016; Terracciano et al., 2017; Ayers et al., 2020; Yoneda, Graham, et al., 2023; Schaeffer et al., 2024), followed by Germany (Kuzma et al., 2011; Wettstein et al., 2016), the United Kingdom (Singh-Manoux et al., 2020), Italy (Terracciano et al., 2022), Switzerland (Rodriguez et al., 2016), and Japan (Nishita et al., 2016). The sample sizes varied widely, ranging from studies with approximately 14,000 participants (Terracciano et al., 2017; Luchetti et al., 2016) to those with as few as 380 participants (Wettstein et al., 2016; Kuzma et al., 2011). The percentage of participants lost at follow-up ranged from 10.5% to 85.5%. Participants' ages ranged from 45 years (Hock et al., 2014) to 81 years (Wettstein et al., 2016), with the majority of studies ($n = 11$) reporting a mean age above 65. Educational attainment was generally medium to high, with only one study reporting a mean of 6.6 years of education (Terracciano et al., 2022). All details are reported in Table S1.

The sex composition varied across studies. Three studies (Kuzma et al., 2011; Nishita et al., 2016; Terracciano et al., 2022) reported a balanced sex distribution. Five studies (Rodriguez et al., 2016; Terracciano et al., 2017; Ayers et al., 2020; Yoneda, Graham, et al., 2023; Schaeffer et al., 2024) included samples with a predominance of female participants. In contrast, one study focused primarily on male participants, with only 27.1% female representation (Singh-Manoux et al., 2020). With regard to race and ethnicity, in studies where data were reported, the majority of the samples were Caucasian (more than 80%), except for one study in which nearly 30% of the participants were African-Americans (Schaeffer et al., 2024). The duration of follow-up across studies ranged from 1.5 years (Rodriguez et al., 2016) to 12 years (Kuzma et al., 2011) (Table S1).

Although the included studies employed various scales to assess personality, the most commonly used tool was the NEO inventory. The short form (NEO-FFI) was adopted in five studies (Kuzma et al., 2011; Nishita et al., 2016; Wettstein et al., 2016; Wilson et al., 2007; Yoneda, Lozinski, et al., 2023), while three studies utilized the long form (NEO-PI-R) (Hock et al., 2014; Rodriguez et al., 2016; Terracciano et al., 2022) (see Table S1). Most studies utilized a combination of validated cognitive assessment scales and clinical evaluations conducted by healthcare professionals, including neuropsychologists, to assess cognitive outcomes. Specifically, four studies (Hock et al., 2014; Nishita et al., 2016; Terracciano et al., 2017; Terracciano et al., 2022) assessed CIND using a single validated performance-based tool, such as the Mini-Mental State Evaluation (MMSE), or the Telephone Interview for Cognitive Status (TICSm). Additionally, three studies (Luchetti et al., 2016; Ayers et al., 2020; Schaeffer et al., 2024) collected data on non-cognitive measures, including dementia, Alzheimer's disease, geriatric depression, and functional abilities such as gait speed (see Table S1).

Regarding the primary outcomes, six studies reported findings on MCI (Wilson et al., 2007; Kuzma et al., 2011; Rodriguez et al., 2016; Ayers et al., 2020; Yoneda, Graham, et al., 2023; Schaeffer et al., 2024), while another six focused on CIND (Hock et al., 2014; Wettstein et al., 2016; Nishita et al., 2016; Terracciano et al., 2017; Singh-Manoux et al., 2020; Terracciano et al., 2022). With respect to secondary outcomes, only one study reported results on MCR (Ayers et al., 2020), and two studies included outcomes related to SCD (Luchetti et al., 2016; Schaeffer et al., 2024) (see Table S2).

3.1. Mild cognitive impairment or cognitive impairment without dementia

Twelve studies focused on the association of personality traits on MCI or CIND. *Extraversion* was evaluated in nine studies, all of which were included in the meta-analysis: no studies found a significant association of this trait on MCI/CIND, and the pooled estimates likewise indicated no significant relationship. The overall estimates show no heterogeneity (I^2 near 0.0%, $H^2 = 1.00$), and there was no significant difference between the two effect size metrics (HRs and ORs) (Fig. 2).

Despite a significant degree of heterogeneity in the HR group ($I^2 = 87.22\%$, $H^2 = 7.83$), no significant association was found between *agreeableness* and MCI/CIND. Similarly, no overall association was found for *conscientiousness*; however, the findings for this trait were inconsistent. Although the pooled results were not statistically significant, HRs suggested a negative association with MCI/CIND (protective effect), whereas ORs indicated a positive association (increased risk). In addition, the HR estimate exhibited high heterogeneity ($I^2 = 92.89\%$, $H^2 = 14.06$). Two additional studies not included in the meta-analysis also reported effect sizes for *conscientiousness*. Wilson et al. (2007) found a negative association with MCI only in the unadjusted model; in the adjusted model, the relationship was no longer significant. While Hock et al. (2014) reported a positive linear beta coefficient, suggesting that higher levels of *conscientiousness* were associated with a better cognitive performance (Table S2). Regarding *agreeableness*, Hock et al. (2014) corroborated this quantitative synthesis as they found no association with CIND (Table S2).

Neuroticism was examined in nine studies included in the quantitative synthesis. A modest association with MCI/CIND was observed when Hazard Ratios were included (HR 1.08, 95% CI 1.02–1.15); however, this subgroup estimates exhibited substantial heterogeneity ($H^2 = 5.34$, $I^2 = 81.27\%$). Studies reporting Odds Ratios (ORs) showed a smaller effect size that was not statistically significant (Fig. 2). The test for group differences indicated no statistically significant difference between the HR and OR estimates ($p = 0.28$). Studies not included in the meta-analysis confirmed this trend; however, only the study by Hock et al. (2014) was statistically significant, while the study of Wettstein et al. (2016), showed a non-significant association (Table S2).

Finally, the quantitative synthesis incorporated data from eight

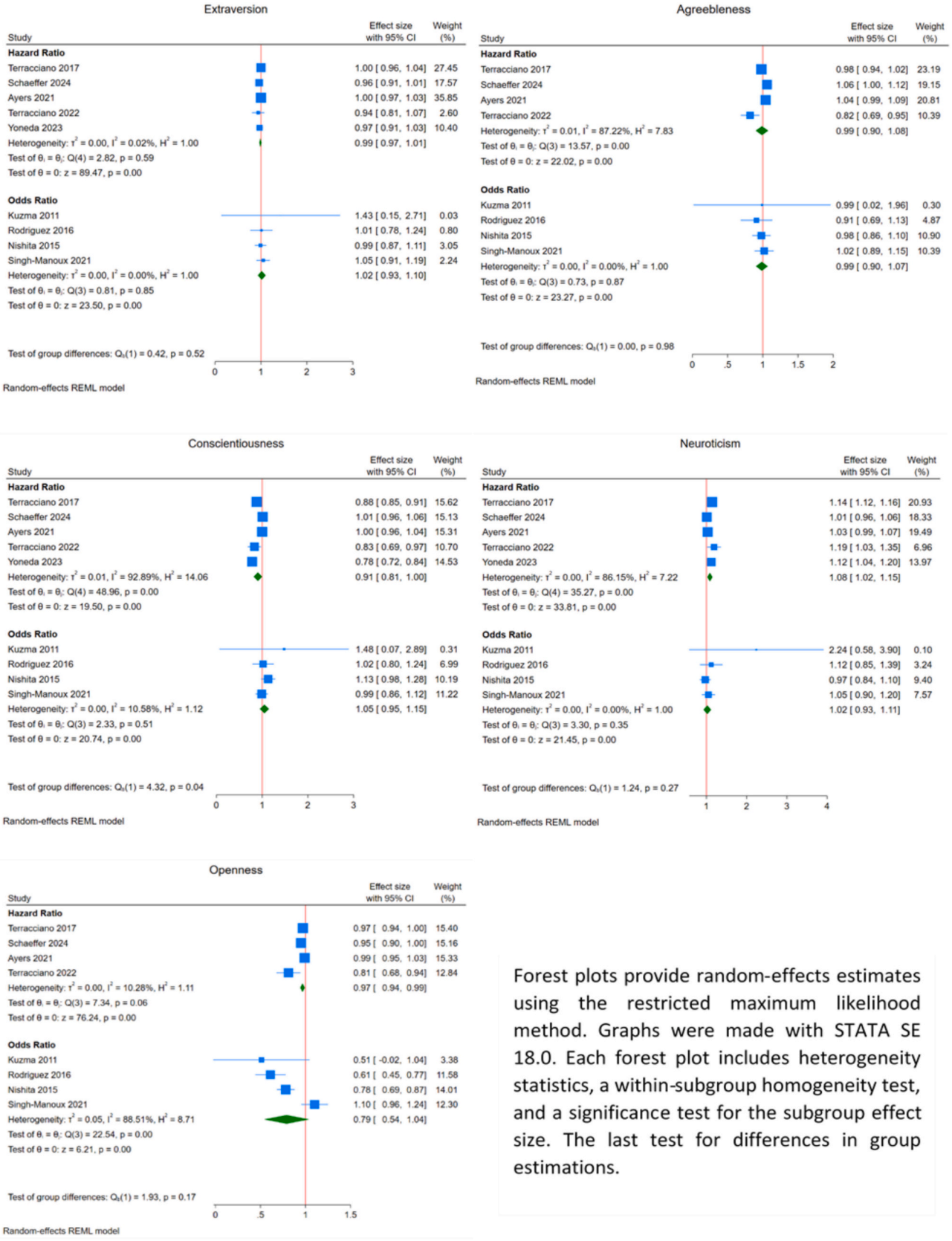

Fig. 2. Forest plots for the five personality traits and MCI/CIND by type of effect size measure.

studies that reported on *openness*. Although all groups found a negative association between *openness* and MCI/CIND, only the HR group had a significant estimate (HR 0.97, 95% CI 0.94–0.99) with acceptable heterogeneity (I^2 = 10.28%, H^2 = 1.11). The ORs estimate was neither statistically significant nor heterogeneous (Fig. 2). Hock et al. (2014) showed a non-significant association between *openness* and CIND (Table S2).

3.2. Motoric cognitive risk syndrome

Ayers et al. (2020) were the only authors to present data for this outcome in relation to all five personality traits. Only *openness* had a significant negative relationship with MCR (HR 0.94, 95% CI 0.89–0.99), suggesting a potential protective effect (Table S2).

3.3. Subjective cognitive decline

Two studies reported findings on subjective cognitive decline in relation to the Big Five personality traits. Luchetti et al. (2016) found negative associations for *agreeableness* and *neuroticism* and positive associations for *openness*, *conscientiousness*, and *extraversion*. It is important to note that in their study, lower scores on the SCD items indicate greater perceived decline. This negative association actually reflects an increased risk of SCD. Conversely, Schaeffer et al. (2024) reported a positive relationship only for *neuroticism* (HR 1.06 95% CI 1.00–1.11) and a negative one for *conscientiousness* (HR 0.92 95% CI 0.88–0.98), aligned with the risk-related trends found in Luchetti et al. (2016) (Table S2).

3.4. Analysis of heterogeneity for meta-analytical estimates

Table 1 presents the results of subgroup meta-analyses and meta-regression conducted to investigate potential sources of heterogeneity. *Neuroticism*, *agreeableness*, and *conscientiousness* (within the HR groups) exhibited substantial heterogeneity across the different follow-up durations reported by the studies. Given the small numbers of studies per stratum, this analysis should be considered strictly exploratory. Meta-regression revealed that duration of observation had a moderating effect, statistical accounting for a high proportion of the variance (see R^2 in Table 1). As shown in the cumulative meta-analysis (Fig. 3), the associations between *neuroticism* with MCI/CIND strengthened over time, becoming significantly positive. Conversely, the associations for *agreeableness* and *conscientiousness* shifted, from null to significantly negative (protective) as follow-up duration increased. Specifically, the link between *conscientiousness* and MCI/CIND (for HRs) became increasingly negative and reached statistical significance as the length of the follow-up extended. While the regression coefficients were statistically significant and residual heterogeneity within this small sample size was reduced (refer to I^2 of meta regression in Table 1), these findings are highly tentative given that some subgroups rely on only 2 to 3 studies, preventing definitive conclusions about what drives between-study variability.

The heterogeneity observed in the Odds Ratio (OR) group for *openness* (Fig. 2) was fully accounted by the sex composition of the study samples. Specifically, the association between *openness* and MCI/CIND strengthened and became statistically significant as the sample composition shifted from predominantly male samples to sex-balanced samples, and became even more pronounced in predominantly female samples. Additionally, the strength of these associations was moderated by follow-up duration: stronger effects were observed in studies with longer observation periods compared to those with shorter durations. These findings align with the direction of the overall meta-analytic estimates (Fig. 2), where higher levels of *neuroticism* were associated with increased risk of MCI/CIND in long-term follow-ups, while higher levels of *agreeableness* and *conscientiousness* exhibited a protective effect. The negative association observed in the OR group for *openness* was further supported by subgroup analyses and meta-regression, indicating that *openness* exerts a potential protective effect against MCI/CIND, particularly among female participants.

3.5. Small-study effects test and publication bias

Egger's tests for small-study effects were not statistically significant for the majority of the meta-analyses performed ($p > 0.05$), with the exception of studies reporting HR effect sizes for the association between the *openness* and MCI/CIND ($p = 0.013$). A meta-analysis adjusted for

Table 1
Subgroup meta-analysis and meta regression for heterogeneous estimates.

Moderator	Subgroups meta-analysis					Meta regression					
	Number of studies	Effect size (CI 95%)	I^2	H^2	*p*-Value*	Coeff. beta (CI 95%)	*p*-Value	R^2	I^2	H^2	*p*-Value**
Neuroticism											
Follow-up											
1–5 years	2	1.02 (0.99–1.05)	0.00	1.00	<0.0001	1					
≥6 years	3	1.14 (1.12–1.16)	0.01	1.00		0.03 (0.01–0.04)	0.006	75.27	56.68	2.31	0.078
Agreeableness											
Follow-up											
1–5 years	2	1.05 (1.01–1.09)	0.04	1.00	0.097	1					
≥6 years	2	0.91 (0.76–1.07)	81.19	5.32		−0,03 (−0.04 to −0.01)	0.001	100.0	0.05	1.00	0.424
Conscientiousness											
Follow-up											
1–5 years	2	1.00 (0.97–1.04)	0.03	1.00	<0.0001	1					
≥6 years	3	0.84 (0.76–0.91)	68.86	3.21		−0.04 (−0.05 to −0.02)	<0.0001	95.54	36.41	1.57	0.121
Openness											
Sex composition of samples											
Mostly male	1	1.10 (0.96–1.24)			<0.0001	1					
Balanced	2	0.77 (0.68–0.86)	0.00	1.00		−0.33 (−0.50 to −0.16)	<0.0001	100.00	0.00	1.00	0.326
Mostly female	1	0.61 (0.44–0.76)				−0.49 (−0.71 to −0.27)	<0.0001				

* Test of group differences.
** Test of residual homogeneity.

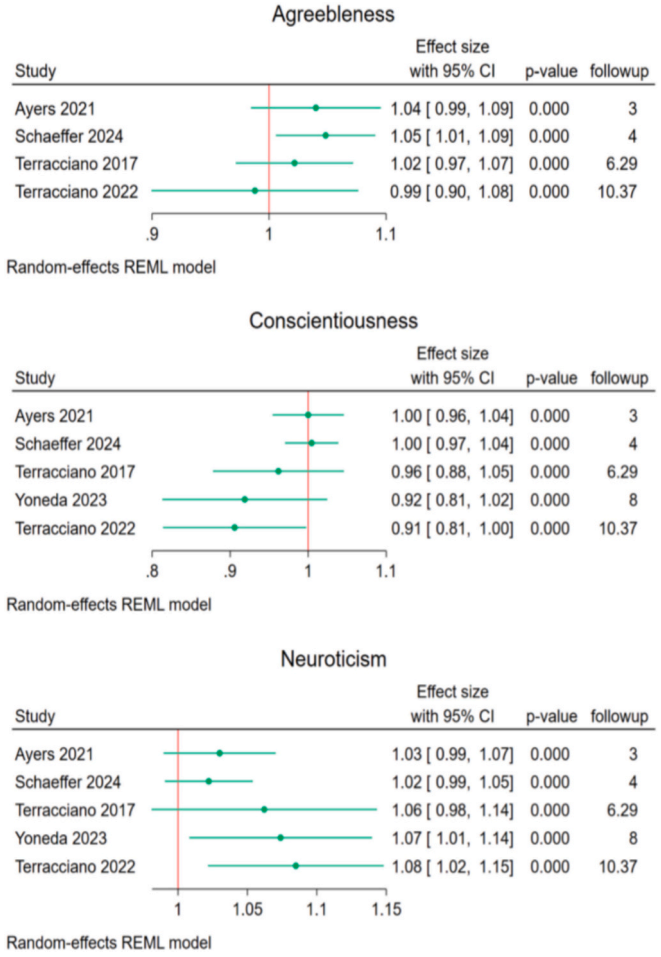

Fig. 3. Cumulative forest plot on follow-up length (in years) of studies observed associations between agreeableness, conscientiousness, and neuroticism, HR groups.

publication bias (using trim-and-fill method) was conducted to estimate the impact of potentially missing studies. This adjustment revealed a slightly attenuated association that became non-statistically significant (0.98 95% CI 0.92–1.03). Fig. 4 depicts a funnel plot using observed and imputed data.

3.6. Critical appraisal

As shown in Table S3, the included studies were generally of high quality, meeting approximately 90% of the JBI checklist criteria. The study by Hock et al. (2014) met the fewest criteria, with notable limitations related to the validity of the outcome assessment method, the short follow-up duration, and the absence of reported strategies to address incomplete follow-up. Regarding the validity of outcome measurement, the studies by Nishita et al. (2016) and both studies by Terracciano et al. (2022, 2017) were assessed as methodologically limited in this domain. Furthermore, Kuzma et al. (2011) and Wettstein et al. (2016) did not account for all relevant confounding factors. In addition, several studies did not clearly report whether they addressed incomplete follow-up, including those by Wilson et al. (2007), Rodriguez et al. (2016), Ayers et al. (2020), Yoneda, Graham, et al. (2023), and Schaeffer et al. (2024). This issue was also not discussed in the studies by Kuzma et al. (2011) and Singh-Manoux et al. (2020).

4. Discussion

This paper presents the findings of a systematic review and meta-analysis examining the association between personality traits defined by the Big Five model (McCrae and John, 1992) and pre-dementia condition in aging populations. The meta-analytic synthesis provides evidence for significant associations between certain personality traits and the incidence of various pre-dementia conditions, including Mild Cognitive Impairment (MCI), Cognitive Impairment without Dementia (CIND).

In particular, *neuroticism* appears to be positively associated with the risk of developing MCI or CIND over longer follow-up periods. Several studies showed that *neuroticism* is robustly linked to the early stages of cognitive decline, acting as a predictor for cognitive impairment alongside chronic stress, depression, and anxiety, psychological conditions that are themselves linked to an increased risk of MCI and dementia (Troisi et al., 2024; Steffens et al., 2023; Yoneda, Lozinski, et al., 2023; Almeida et al., 2017). The associations between *neuroticism* and MCI/CIND emerges more clearly in studies with longer follow-up

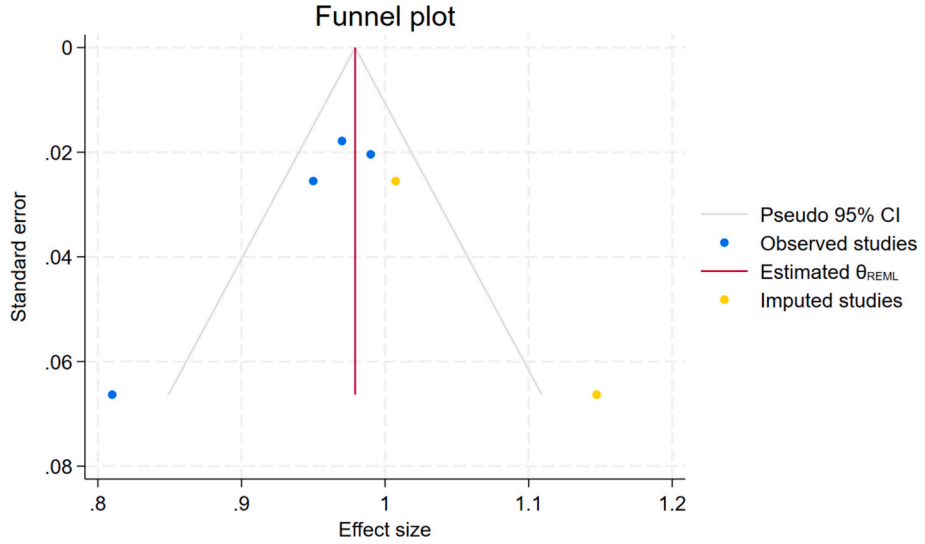

Fig. 4. Funnel plot of meta-analysis of studies observed associations between openness and MCI/CIND, HR group.
The funnel plot shows the effect size of the included studies and the imputed studies using the "trim-and-fill" method to adjust for publication bias. The yellow dots show papers that are possibly missing from the meta-analysis due to publication bias. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

periods. This is likely because extended observation increases the probability of detecting these conditions as they develop over time. Furthermore, prolonged exposure to certain psychological traits, such as high *neuroticism*, may be cumulatively associated with poorer cognitive health over time. It is important to emphasize that this association is significant in the meta-analytic synthesis of hazard ratios (HRs), which, capture a different estimated by accounting for the specific timing of events when time to event information is available. However, it is crucial to note that the meta-analytic estimate for HR was highly heterogeneous ($I^2 = 86.15\%$). Although meta-regression demonstrated that this heterogeneity drops to a moderate level when accounting for follow-up duration ($I^2 = 56.8\%$; Chandler et al., 2019). Conversely, the lack of significant effect in the studies reporting Odds Ratios (ORs), highlights how these two metrics address distinct epidemiological questions; furthermore, OR estimates can be highly sensitive to outcome incidence over time. Therefore, these interpretations should be treated with caution, as the association may be robust only under specific longitudinal conditions and statistical framework.

Regarding *openness*, our finding initially suggested an association with a reduced risk of developing MCI/CIND, aligning with the hypothesis that this trait contributes to cognitive reserve (Coors et al., 2024; Corbo et al., 2023; Montoliu et al., 2023; Berezuk et al., 2021). Specifically, *openness* showed a positive association with reduced risk of MCI/CIND in studies using HRs as effect size. In contrast, results from studies using ORs were non-significant and highly heterogeneous. While stratified analyses appeared to suggest a stronger trend in sex-balanced or predominantly female samples, this particular subgroup pattern must be interpreted with caution. Because these strata are driven by a very limited number of cohorts, this pattern likely reflects study-level difference rather than true sex-based moderation. Furthermore, a more cautious interpretation is strictly required: after adjusting for publication bias using the trim-and-fill method, the association between openness and a reduced risk of MCI/CIND lost its statistical significance (HR 0.98, 95% CI: 0.92–1.03). This indicate that the evidence for *openness* remains merely suggestive and highly sensitive to small-study effects, as well as subgrouping decision regarding sex composition. Consequently, while it is theoretically reasonable to view *openness* as a protective factor, further research is needed to reach a more definitive conclusion regarding its impact on the incidence of pre-dementia conditions. As established in the literature, lower levels of *conscientiousness* are associated with an increased risk of developing dementia (Aschwanden et al., 2021). Several authors have emphasized that this relationship may be mediated by health-related behaviors, such as physical activity, healthy diet, and adherence to medical advice (e.g., Sutin et al., 2011; Wilson et al., 2007). Conversely, alternative evidence suggested that higher levels of *conscientiousness* might be observed in individuals with mild cognitive impairment as a compensatory mechanism, where increased conscientious effort serves to offset emerging cognitive deficits (e.g., Moutafi et al., 2004; Soubelet, 2011). Despite these differing interpretations, this meta-analysis identified a significant association between *conscientiousness* and pre-dementia conditions in longitudinal studies. Specifically, *conscientiousness* demonstrated a protective effect against MCI/CIND, but only in studies with longer follow-up periods and when hazard ratios (HRs) were employed as the effect size. In contrast, studies using Odds Ratios (ORs) pointed in the opposite direction, suggesting a trend toward an increase risk, although the pooled estimate did not reach statistical significance. This discrepancy between effect size metrics reflects the substantial heterogeneity of the pooled evidence and is not necessarily problematic, as HRs and ORs target fundamentally different estimands rather than one being inherently superior to the other. ORs represent a valid approach to evaluating cumulative risk but can be sensitive to variation in outcome incidence across cohorts. On the other hands, HRs provide highly informative data regarding the rate of occurrence, provided that detailed time-to-event information is available and proportional hazard assumptions are fully met. In this review, three out of the five included studies reported meeting the proportional hazards assumptions (Terracciano et al., 2022, 2017; Ayers et al., 2020).

While a previous systematic review and meta-analysis found that lower levels of *agreeableness* and *extraversion* were associated with an increased risk of dementia (Aschwanden et al., 2021), the evidence appears to differ when considering pre-dementia conditions. Specifically, several studies have failed to find consistent associations between these traits and conditions such as MCI or CIND (Curtis et al., 2015; Troisi et al., 2024). The current meta-analysis confirms these findings: neither *extraversion* nor *agreeableness* showed a significant association with these pre-dementia conditions across both short and long follow-up periods. However, regarding *agreeableness*, a positive but non-significant trend emerged in studies with longer follow-up durations, suggesting a potential (albeit weak) protective role of this trait in the development of MCI/CIND. Further research is needed to more thoroughly explore how *extraversion* and *agreeableness* may be linked to incidence of pre-dementia conditions.

Regarding SCD, only *neuroticism* appears to be a potential risk factor; however, the limited number of studies examining this association precludes drawing definitive conclusions. SCD is a complex and evolving construct. According to Jessen et al. (2014), its core features include a self-perceived decline in cognitive abilities despite the absence of objective impairment on standardized neuropsychological tests. A primary challenge in studying SCD is the lack of standardized diagnostic criteria, which has resulted in significant variability in assessment methods across studies (Pike et al., 2022), a pattern also evident in the current review. For instance, Luchetti et al. (2016) assessed SCD using a single self-report question on memory perception, while Schaeffer et al. (2024) employed a more comprehensive cognitive evaluation battery. This methodological heterogeneity, coupled with the scarcity of longitudinal research examining the relationship between personality traits and SCD, significantly limits the strength and generalizability of current findings.

Regarding MCR, *openness* appears to play a potential protective role. However, this finding should be interpreted with caution, as it is based on a single study included in this review (Ayers et al., 2020). To our knowledge, only one other study has examined the relationship between MCR and personality traits as defined by the Big Five personality traits. This cross-sectional study by Stephan et al. (2020) found that *neuroticism* was associated with an increased risk of MCR, whereas *openness*, *agreeableness*, and *conscientiousness* were linked to a decreased risk. Nevertheless, due to its cross-sectional design, causal inferences cannot be made. Overall, the evidence linking personality traits to both SCD and MCR remain heavily limited and preliminary. Further well-powered, longitudinal research is essential to clarify these associations and address the significant underexplored nature of these specific pre-dementia conditions.

A key strength of this study is the longitudinal design of all included studies, which establishes temporal precedence and allows for a more confident estimation of the incidence of pre-dementia conditions in relation to personality traits. Furthermore, the use of a meta-analytic approach provides robust and comprehensive evidence by synthesising data across diverse populations. By restricting the meta-analyses to fully adjusted models, this study offers a more precise estimation of the independent effects of personality on pre-dementia, while minimizing confounding bias. While the subgroup meta-analysis is constrained by the limited number of studies, both meta-regression and cumulative meta-analysis supported the influence of follow-up as a moderating factor for the observed associations. This method allowed for systematic exploration of several sources of heterogeneity, thereby increasing precision and reliability of the pooled meta-analytic estimates. However, due to the voluntary nature of these longitudinal studies, a high dropout rate was observed at follow-up. This phenomenon is common in cohort studies and could introduce selection bias, potentially hindering the generalizability of the results. Since the studies included in the meta-analysis did not report specific strategies to control for the impact of loss to follow-up, it is possible that attrition bias may have influenced the

observed estimates. In longitudinal aging cohort attrition is rarely random; itis frequently driven by cognitive decline, physical frailty, or mortality. This selective drop-out likely attenuates the observed incidence of pre-dementia conditions and dilutes the true strength of the associations, thereby biasing the pooled estimates toward null.

Conversely, our protocol rule of selecting the longest follow-up for studies reporting multiple waves may have over-strengthened pooled associations and inflated between-study heterogeneity, as wider risk windows naturally yield more incident cases. This time-dependent strengthening is evidenced by our exploratory meta-regressions and cumulative analyses, where traits like *neuroticism*, *conscientiousness*, and *agreeableness* showed a monotonic increase in effect magnitude with expanding follow-up windows. Readers should therefore interpret the absolute magnitude of these pooled estimates with caution, keeping in mind that they represent integrated, varying windows of exposure.

The small number of studies included in the meta-analysis, as only nine met the inclusion criteria, further limits the robustness of the conclusions regarding the effect of personality on pre-dementia conditions, especially for subgroup pooled estimates. However, given the specificity of the topic, this number is not unexpected; most existing studies on personality and cognition are either cross-sectional or focused on dementia rather than pre-dementia such as MCI, CIND, SCD, or MCR. Furthermore, the individual studies tend to include participants who are not fully representative of the general population. Most samples were skewed in terms of sex (predominantly female), had high levels of education, and were largely composed of individuals of white ethnicity. Education level is a relevant variable for the evaluation of cognitive decline; although our sample is skewed toward people with high levels, we included at least one study with a sample of people with low education levels (Terracciano et al., 2022). Regarding sex differences, this variable does not seem particularly relevant for detecting pre-dementia conditions (Au et al., 2017). Similarly, the low representation of ethnoracial minorities could have biased our results, especially considering the disadvantaged contexts often experienced by these populations. Nonetheless, the inclusion of studies from various regions including North America, Europe, and Asia may help mitigate some of this sampling bias. Still, these findings may not be generalizable to individuals with different socio-demographic or socio-cultural backgrounds.

Another aspect to consider concerns how the outcome was assessed across the included studies. Jointly analysing MCI and CIND preserves statistical power but risks masking trait-specific associations. Descriptively, directions of association were consistent across subsets for *extraversion*, *agreeableness*, *openness* and *neuroticism*, suggesting pooling introduced minimal bias for these traits. However, patterns diverge for *conscientiousness*: CIND studies consistently showed protective associations, whereas MCI finding were mixed. Furthermore, because CIND samples were considerably larger, pooled estimates heavily reflected CIND-defined case mixes. This descriptive comparison suggest that pooled associations for *conscientiousness* should be interpreted with caution, as they may not generalize equally across pre-dementia conditions.

Furthermore, three study relied on a single tool to detect CIND (Nishita et al., 2016; Terracciano et al., 2017; Terracciano et al., 2022). Relying exclusively on the Mini Mental State Examination (MMSE) can be problematic as it lacks sufficient sensitivity to reliably detect mild cognitive impairment (Mitchell, 2017). Although the MMSE serves as a common benchmark for global cognitive function, its isolated use introduces potential misclassification bias, as individual with early-stage MCI or CIND may score within normal rages. While utilizing a single brief tool is often a pragmatic necessity in long-term, logistically complex population-based cohort, future studies would benefit from adopting brief instruments with superior diagnostic accuracy for pre-dementia stages. For instance, the Montreal Cognitive Assessment (MoCA) has demonstrated better sensitivity overall performance in differentiating MCI form normative aging compared to the MMSE (Ciesielska et al., 2016; Pinto et al., 2019).

Furthermore, while this meta-analysis focused on broad personality traits, examining personality at the facet level may provide more nuanced insights into the relationship between personality and cognitive outcomes (Rammstedt et al., 2018). For example, certain *neuroticism* facets, such as *self-consciousness* and *vulnerability to stress*, have been shown to be more strongly associated with an increased risk of developing MCI (Kumar et al., 2022; Manning et al., 2017). Similarly, facets of *conscientiousness*, including *responsibility*, *self-control*, and *industriousness*, have been linked to a reduced risk of CIND and better cognitive performance (Sutin et al., 2022; Sutin et al., 2023). Additionally, all the facets of *conscientiousness* with the exception of *self-control* were associated with a lower risk of incident MCR (Stephan et al., 2022). These findings further support the hypothesis that *conscientiousness* may serve as a protective factor against pre-dementia. Moreover, in the Terracciano et al. (2022) study, several facets of the Big Five were taken into account. While *extraversion* was the only trait that did not show a significant association with CIND, at the facet level, it appeared that the *warmth* is associated with a reduced risk of CIND (HR: 0.76, 95% CI: 0.66–0.89). Similar pattern appears in the work by Rodriguez et al. (2016), which revealed that *openness* was the trait with the highest number of facets associated with decreased risk of MCI. Also, they found that while overarching trait of *agreeableness* showed no specific association, its specific facet of *tender-mindedness* was linked to better cognitive performance. Taken together, these examples emphasize, that studying the personality at facet level is essential for identifying effects that might be overlooked when only the trait level is considered.

5. Conclusion

This meta-analysis suggests that personality traits are associated with pre-dementia risks. Crucially, the bulk of current evidence concentrates on MCI and CIND, linking higher *neuroticism* to increased risk, and *conscientiousness* and *openness* to lower risk. Evidence for SCD and MCR remains highly preliminary due to the limited number of available studies. To move forward, future research must prioritize longitudinal designs, standardized assessment tools, and diverse cohorts (e.g. ethnoracial minorities and lower socio-economic backgrounds). Ultimately, more robust evidence will be instrumental in developing tailored interventions aimed at promoting health and well-being in aging populations.

CRediT authorship contribution statement

Marco Martorana: Writing – original draft, Software, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Silvia Caristia:** Writing – original draft, Visualization, Software, Methodology, Formal analysis, Data curation. **Cristina Meini:** Writing – review & editing, Supervision, Funding acquisition. **Fabrizio Faggiano:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used Gemini (Google) in order to refine the language and improve grammatical accuracy of the manuscript. After using this tool, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the published article.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2026.113976.

Data availability

Data will be made available on request.

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