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Review article

Does personality affect the cognitive decline in aging? A systematic review

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ABSTRACT

Cognitive decline is a natural consequence of aging, but several genetic, environmental, and psychological factors can influence its trajectories. Among the most enduring factors, the Big Five personality traits – defined as relatively stable tendencies to think, behave, and react to the environment – can influence both directly (e.g., by physiological correlates) and indirectly (e.g., healthy or risky behaviors) the risk of developing dementia and mild cognitive impairment (MCI) – a preclinical form of cognitive decline. Despite the great amount of studies focusing on the relationship between personality and cognitive decline, an updated systematic synthesis of the results including a broader range of study designs is still lacking. This systematic review aims to summarize the findings of studies investigating: (i) differences in personality traits between groups of healthy individuals and those with MCI, (ii) the impact of personality traits on the risk for both MCI and dementia, and (iii) changes in personality traits among individuals progressing from normal cognition to MCI. Neuroticism emerged as a significant risk factor for MCI and dementia; Conscientiousness and Openness appear to offer protection against dementia and moderate cognitive decline. Overall, these findings suggest a pivotal role of personality structure in shaping cognitive outcomes on the long run.

1. Introduction

1.1. An aging population

The global population of individuals aged 60 and over is increasing rapidly, resulting in longer lifespans worldwide (Antoniou and Wright, 2017). The World Health Organization (World Health Organization Website, 2022) has estimated that by 2030, one out of every six people worldwide will be 60 years or older.

Although an extended lifespan is often viewed positively (He et al., 2016), the progressive loss of physiological integrity (López-Otín et al., 2013) represents the other side of the same coin. Aging is a biological process that involves a time-dependent decline in physical and cognitive domains (Bettio et al., 2017). Age-related cognitive decline is one of the most impactful aspects of older adulthood in terms of costs (e.g., financial and societal burdens) and personal well-being (Deary et al., 2009). Nevertheless, many individual differences can influence the degree of the impairment.

According to recent definitions (Jack et al., 2011; Smith, 2016), cognitive aging can be represented by a continuum of possible outcomes, ranging from "normal cognitive changes" to "dementia", a progressive and neurodegenerative disease that reduces the sufferer's ability to cope with daily-life activities and impairs cognitive control and social behavior (Browne et al., 2021; Eschweiler et al., 2010; Guarino et al., 2019).

Dementia affects over 55 million people worldwide and is a leading cause of disability among older populations (WHO, 2022). The loss of functional independence is a core aspect of this condition, with overwhelming consequences for both sufferers and their caregivers. The need for great psychological, medical, and economic resources often leads to caregivers' burden and high costs for families and societies (Roy et al., 2016). Given the considerable increase and impact of dementia, research has focused on detecting possible precursors and early diagnosis, along with modifiable risk factors, in order to predict disease development and improve interventions that could slow down symptoms progression (Eshkoor et al., 2015; Petersen et al., 2014).

From this perspective, Mild Cognitive Impairment (MCI) has received considerable attention in the last decades (Petersen et al., 2014). The concept of MCI was introduced in the late 1980s (Reisberg et al., 1988) to identify individuals at an intermediate stage between

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normal cognition and dementia. In later years, the concept of MCI has been extended. MCI has been recognized as a condition in which functional independence is preserved, but cognitive impairment occurs in one or more domains compared to the appropriate normative data for the specific individual in the absence of dementia (Petersen et al., 2014). Furthermore, two main subtypes of MCI have been identified: amnestic (aMCI) and non-amnestic MCI (naMCI), depending on whether the deficit concerns memory or other cognitive domains (Corbo and Casagrande, 2022; Petersen et al., 2001).

Although the heterogeneity of the diagnostic criteria and the methodology causes wide variability in its prevalence (for a review, see Casagrande et al., 2022), this preclinical condition can represent an important turning point in cognitive aging since MCI can be a precursor of dementia (with a rate of 10–15 %; Petersen et al., 2001; Xue et al., 2019), but it can also remain stable (Xue et al., 2019) or revert to normal cognition (with a rate of 27.57 %; Xue et al., 2019).

1.2. How could the big five personality traits affect cognitive decline?

Given the inter-individual differences in the outcome of MCI, research has investigated several genetic (e.g., presence of the APOE4 gene), psychological (e.g., depression, anxiety), and environmental (e.g., educational level, socio-economic status) factors that could influence the trajectories of this condition. For this reason, protective and risk factors for dementia and its preclinical forms have been extensively studied. Specifically, different persistent psychological traits have been found to mediate the effects of genetics and contribute to inter-individual differences in cognitive decline (Terracciano and Sutin, 2019).

Personality is one of these psychological factors and has received great attention in the last decades due to its persistence and stability throughout an individual's lifespan (Low et al., 2013; Roy et al., 2016; Terracciano et al., 2017a). Personality refers to the dispositions that underlie the cognitive, affective, and behavioral processes of an individual (Terracciano et al., 2014). Thus, individuals can develop different responses to stress and engage in various health behaviors and physical, social, and cognitively stimulating activities throughout their lifespan (Terracciano and Sutin, 2019). These factors can influence cognition and aging profiles.

The Five Factor Model (FFM), also known as the "Big Five", is the most widely accepted taxonomy of human personality (McCrae and Costa, 1997). It has been supported across languages (Davey et al., 2015) and describes personality dimensions that are considered phenotypes shaped by the interactions between genetic and environmental inputs (Dar-Nimrod et al., 2012a; Hernandez and Blazer, 2006). According to this theoretical framework, personality can be described by five main domains: Neuroticism, Openness, Extraversion, Conscientiousness, and Agreeableness (McCrae and Costa, 1997). These five traits are recognized as the minimum number required to comprehensively and accurately describe personality phenotypes across cultures (Segerstrom, 2020).

Neuroticism is a personality trait characterized by emotional instability and a tendency to experience negative affects, such as anger, anxiety, and irritability (Costa and McCrae, 1992; Curtis et al., 2015; Duberstein et al., 2011). Individuals with higher levels of Neuroticism can perceive neutral situations as threatening and experience higher levels of distress (Widiger and Oltmanns, 2017). This trait has been extensively studied in the field of cognition due to its physiological correlates (Shepherd et al., 2015). In fact, individuals with higher levels of Neuroticism exhibit elevated autonomic reactivity and dysregulation in the hypothalamic-pituitary-adrenal (HPA) axis as a result of the negative affectivity (Ormel et al., 2013). This frequent autonomic arousal can cause neuronal damage over time, leading to negative outcomes in cognitive abilities (Terracciano et al., 2021). Autonomic dysregulation has been associated with chronic diseases, depression, hippocampal atrophy, and Alzheimer's disease (Terracciano et al., 2021).

Openness – also known as "Openness to Experience" – is a personality trait that is characterized by creativity, curiosity, and a willingness to explore new ideas and experiences. Individuals with higher levels of this trait are typically more interested in novelty. Openness may have a positive impact on cognition in the long term. In fact, engaging in creative thinking and actively seeking out cognitively stimulating experiences can enhance cognitive reserve (Curtis et al., 2015). This can result in a greater ability to utilize cognitive networks and strategies flexibly. Therefore, individuals with higher levels of Openness can develop greater cognitive flexibility and coping resources to deal better with brain damage and age-related changes (Stern, 2009).

Extraversion, which is characterized by assertiveness and a preference for social interactions, is opposed to introversion, which is characterized by a focus on one's internal world and the establishment of fewer but more profound social relationships (Costa and McCrae, 1992). Extraverted individuals may have better memory abilities due to their higher positive affect, which creates contextual cues that are stored with the memory trace and enhances retrieval (Allen et al., 2011). From another perspective, research has shown that individuals with higher levels of extraversion may be more easily distracted by external stimuli, leading to poorer performances in memory tasks (Chapman et al., 2012). Extraverted people have a low level of cortical activation, while introverted individuals present a high level of cortical arousal (Küssner, 2017; Roslan et al., 2017). This difference in cortical arousal can partially account for differences in cognitive performance. Recent findings suggest that older individuals with higher traits of Extraversion and/or Openness can experience greater subjective well-being. This may be due to their tendency to view life events as challenges rather than threats (Chan et al., 2018).

Conscientiousness is a trait that identifies an individual's tendency to be persistent, organized, and goal-directed and to exhibit self-control and self-discipline. Individuals with higher levels of Conscientiousness tend to maintain more efficient cognitive functioning as they age (Sutin et al., 2022). Additionally, higher levels of this trait can promote healthier behaviors that could be protective against age-related brain changes (Bugg and Head, 2011). From another point of view, it is also plausible that better cognitive functioning in older age could positively influence conscientious behaviors (Möttus et al., 2012).

Finally, Agreeableness refers to the tendency to be altruistic, trusting, and modest (Duberstein et al., 2011). It also refers to an individual's motivation to maintain positive relationships with others (Jensen-Campbell and Graziano, 2001). Individuals with higher levels of agreeableness are more sympathetic to others and often more popular than those who are less agreeable (Robins Wahlin and Byrne, 2011). However, the extent to which this trait can contribute to age-related changes in cognition remains unclear.

In the last decades, numerous cohort longitudinal studies (e.g., ELSA, HRS), meta-analytic studies (e.g., Aschwanden et al., 2020a), and systematic reviews (e.g., Low et al., 2013) have investigated the relationship between personality traits and dementia. This significant body of scientific research highlights the increasing recognition of the impact of personality on our behavior and mental health. However, there are still gaps in our understanding of how personality impacts cognitive decline, particularly in conditions such as mild cognitive impairment (MCI) and dementia, despite the extensive research in the field. The need for a thorough systematic review on the topic is evident, given that the most recent systematic review on this topic is a decade old and included measures of personality built on different theoretical frameworks (Low et al., 2013). Additionally, recent meta-analyses have mainly focused on longitudinal studies, excluding results from cross-sectional investigations. Furthermore, the majority of the studies have considered dementia, with limited focus on preclinical forms of cognitive decline such as MCI. Therefore, it is crucial to synthesize and assess the available evidence on this topic.

The primary research question guiding the present systematic review

was: How do personality traits, as defined by the Five-Factor Model, influence the risk and progression of cognitive decline, including MCI and dementia, in aging populations? Understanding how personality traits influence cognitive aging has significant implications for individuals and society. Identifying traits that predispose individuals to cognitive decline can inform targeted interventions for healthy aging. Insights from this review may lead to personalized approaches to cognitive health and help identifying people at higher risk for cognitive decline.

2. Methods

This review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. According to the PRISMA Checklist, the study protocol was registered on PROSPERO (www.crd.york.ac.uk/prospero) and approved with the registration number "CRD42023425498". An overview of the inclusion stages is available in Fig. 1.

2.1. Search strategies

The final search was conducted on January 3, 2024, using the following databases: MEDLINE, PsycINFO, Scopus, and Web of Science. Only articles published in peer-reviewed journals were selected.

The search strategy used the following string for each database: ("big five" OR "five factor*" OR "neuroticism" OR "extraversion" OR "openness" OR "agreeableness" OR "conscientiousness") AND ("mild cognitive impairment" OR "MCI" OR "elderly" OR "old*" OR "dementia" OR

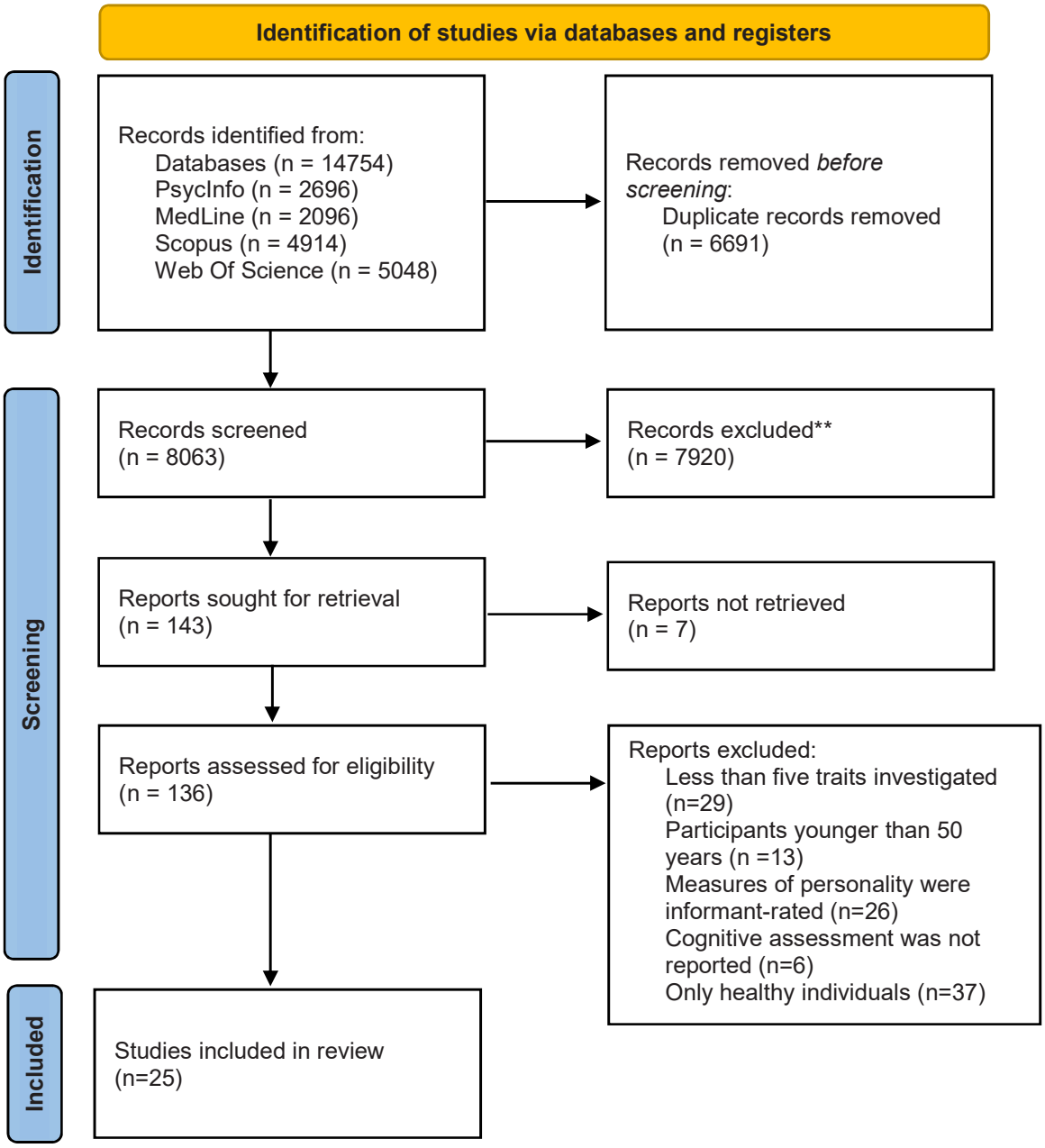

Fig. 1. PRISMA Flow-chart*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.*From:* Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.
For more information, visit: http://www.prisma-statement.org/.

"Alzheimer" OR "AD"). The search was limited to academic publications written in English or Italian.

2.2. Eligibility criteria

Records were independently screened and reviewed by two authors in order to include studies that met the eligibility criteria.

Studies were included if they met the following inclusion criteria: (i) participants aged over 50 years; (ii) assessment of cognitive status; (iii) diagnosis of MCI, including both aMCI and naMCI, cognitive decline without dementia (CIND), or dementia (i.e., non-specified dementia, Alzheimer's disease, frontotemporal dementia); (iv) personality assessment conducted according to the Big Five model; (v) investigation of all five personality traits; and (vi) not meeting any of the exclusion criteria described below.

Even though literature suggests that an earliest form of cognitive decline could be identified in Subjective Cognitive Decline (SCD; Jessen et al., 2014), we chose not to include this category in our review. This methodological decision is due to the absence of an objective decline measured by standard neuropsychological assessment in SCD (Sohrabi and Weinborn, 2019).

Studies that involved participants with medical (e.g., cardiovascular diseases, cancer) or psychiatric (e.g., depression, psychoticism) conditions, as well as other forms of dementia (i.e., Parkinson's disease, alcohol-related dementia) were excluded. Additionally, studies that used personality assessment methods based on different theoretical frameworks (e.g., Eysenck personality inventory) were excluded.

Although there is moderate agreement between self-rated personality traits and observers' ratings of premorbid personality, a discrepancy between self- and informant-rated personality has been reported (Terracciano and Sutin, 2019). This evidence, along with a good reliability of self-reported personality measures in individuals with MCI, led to the inclusion of studies in which personality was self-rated by participants in the absence of a diagnosis of dementia.

Only peer-reviewed research studies were included; systematic and narrative reviews, abstracts published in congress books, meta-analyses, and thesis were excluded.

Both cross-sectional and longitudinal studies investigating the relationship between personality and cognitive decline were included. Thus, our review included cross-sectional designs investigating differences in personality traits between groups according to cognitive status (i.e., normal cognitive status, MCI, dementia) and also longitudinal studies that focused on (i) the influence of personality on cognitive decline and (ii) changes in personality among different cognitive states, such as normal cognition and MCI.

2.3. Data collection

The data collection procedure is summarized in the Prisma Flow Chart (Fig. 1). The initial search strategy resulted in the retrieval of 8063 records exported from the databases once duplicate records were automatically removed. These records were screened based on their title and abstract using Mendeley. Two authors independently screened the records according to the inclusion and exclusion criteria. Conflicting

Table 1
Cross sectional studies.

Author (year)	Country	Groups	N (F/M)	Mean age (SD), range	Personality assessment	Diagnostic criteria	Covariates	Results
Berger-Sieczkowski et al. (2019)	Austria	Subjective Cognitive Decline (SCD) na-MCI a-MCI	SCD: 31 (13/18) na-MCI: 67 (48/19) a-MCI: 36 (14/22)	SCD: 67.21 (9.57) na-MCI: 68.90 (9.41) a-MCI: 66.66 (8.98)	Big Five Pluse One Personlinchkeits-inventar (B5PO)	MCI: Petersen's criteria	Age, gender, education, IQ, depression	a-MCI group had lower E, C and O compared to na-MCI and SCD groups.
Donati et al. (2013)	Switzerland	Healthy MCI	Healthy: 90 (65/25) MCI: 63 (43/20)	Healthy: 66.66 (7.67)	French Version of the Structural Interview for the Five-Factor Model	Winblad's criteria		Lower O in MCI to controls. Higher N and lower E for MCI APOE-carriers.
Duchek et al. (2007)	USA	Healthy Very mild dementia of Alzheimer's type (DAT) Mild DAT	Healthy: 131 Vm-DAT: 74 m-DAT: 46	Healthy: 75.1 (10.2) Vm-DAT: 75.2 (9.38) m-DAT: 77.9 (8.93)	NEO-FFI	Stages of dementia: Washington University CDR scale		Higher N in vm-DAT compared to healthy groups. Levels of O decreased from healthy, vm-DAT and m-DAT.
Rouch et al. (2019)	France (Personality Alzheimer Behavior, in French Personnalité Alzheimer COmportement: PACO)	Prodromal AD Mild AD	Prodromal AD: 118 (70/48) Mild AD: 63 (38/25)	Prodromal AD: 79.1 (7.1) Mild AD: 80.9 (5.4)	NEO-PI-R	Prodromal AD: CDR=0.5, MMSE > 19 Mild AD: NINCDS-ADRDA and CDR)	Age, gender, educational level, MMSE	No differences in personality between the two groups.
Roy et al. (2016)	USA	Healthy a-MCI probable AD possible AD	Healthy: 63 (71 %/ 29 %) Patients: 119 (69/ 50)	Healthy a-MCI probable AD possible AD	NEO-FFI	MCI: Petersen's criteria. Probable and possible AD: NINCDS-ADRDA		Patients has lower O compared to healthy group

SD: standard deviation; SCD: Subjective Cognitive Decline; MCI: Mild Cognitive Impairment; a-MCI: amnestic Mild Cognitive Impairment; na-MCI: non-amnestic Mild Cognitive Impairment; AD: Alzheimer's Disease; NEO-FFI: NEO Five Factor Inventory; NEO-PI-R: NEO Personality Inventory Revised; CDR: Clinical Dementia Rating; MMSE: Mini-Mental State Examination; NINCDS-ADRDA: National Institute of Neurological and Communicative Disorders and Stroke and Alzheimer's Disease and Related Disorders Association; N: Neuroticism; E: Extraversion; O: Openness; C: Conscientiousness; A: Agreeableness.

opinions were discussed and resolved by the authors. Then, the full-text of the selected papers was downloaded and read independently by two authors. Only 136 out of the 143 selected records were available for download.

Following the PICOS methodology, the collected information was organized into three tables. Table 1 includes cross-sectional studies, Table 2 includes longitudinal studies investigating the role of personality in the risk for MCI and dementia, and Table 3 includes longitudinal studies analyzing variations in personality occurring with changes in cognitive status. The tables contain information on: (i) author(s) and year; (ii) country; (iii) sample size and demographics (i.e., age, percentage of female/male participants); (iv) cognitive assessment and diagnostic criteria adopted for MCI and/or dementia; (v) Big Five personality assessment; (vi) results.

For the longitudinal studies, information about the time interval between assessments was collected whenever available.

2.4. Quality assessment

Quality assessment was performed using different tools based on study design. The Tool to Assess Risk of Bias in Longitudinal Symptom Research Studies Aimed at the General Population (CLARITY Group at McMaster University) was adopted to assess the following characteristics of each longitudinal study: (i) representativeness of the sample of the general population, (ii) accuracy of the outcome assessment during both baseline and the follow-up, and (iii) the presence of missing data. The JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies was employed for cross-sectional studies, focusing on (i) inclusion criteria definition, (ii) the appropriate outcome measurement, (iii) the presence of confounding variables, and (iv) the proper use of statistical analyses. Quality assessment was conducted by one author (G.T.) and verified by a second author (M.C.). Disagreements were resolved through discussion.

3. Results

The research strategies yielded the inclusion of 25 studies: 17 longitudinal studies that investigated the effect of personality at baseline on the risk of dementia or its pre-clinical syndromes; 3 longitudinal studies that focused on changes in personality traits across cognitive status; and 5 cross-sectional studies that assessed differences in personality traits between participants grouped according to cognitive status. The last systematic review (Low et al., 2013) included fifteen studies, but only three (Duberstein et al., 2011; Kuzma et al., 2011; Wilson et al., 2007) were deemed relevant for this work. This discrepancy is due to the search strategies (e.g., script used, databases consulted) and the inclusion criteria established by the authors. In fact, we decided to include only studies where personality was self-reported by the participants, and the five factors of personality were assessed in order to reduce the heterogeneity of the results. Potential limitations due to this choice are discussed in the proper section of this paper.

3.1. Demographic characteristics

The selected studies for this systematic review were published from 2007 (e.g., Wilson et al., 2007) to 2023 (e.g., Terracciano et al., 2023).

A total number of 47,163 participants were included. The percentage of female participants for each study ranged from 32 % (Terracciano et al., 2013) to 74 % (Yoneda et al., 2022a), with a generally balanced number of females in each study. The age range of the participants was between 50 and 104 years (Terracciano et al., 2023; Yoneda et al., 2022).

Nevertheless, some studies used a sample from the same cohort study, which raises the possibility of overlapping data. Dar-Nimrod et al. (2012) and Duberstein et al. (2011) reported data from the Ginkgo Evaluation of Memory (GEM) study, a cohort study conducted in the United States of America that enrolled participants aged 72 or older (details of the study are available elsewhere: DeKosky et al., 2006); the two selected studies – whose sample sizes were quite different – could have reported data from similar participants. Identifying the follow-up period (T2) investigated in the analyses was impossible.

Similarly, four studies (Stephan et al., 2018; Strickhouser and Sutin, 2021; Terracciano et al., 2017; Terracciano et al., 2023) used data from the Health and Retirement Study (HRS), a nationally representative longitudinal panel study of Americans over the age of 50. Even in this case, the follow-up wave considered in the studies was not identifiable.

The studies were mainly conducted in the United States of America (Ayers et al., 2020; Dar-Nimrod, Chapman et al., 2012; Duberstein et al., 2011; Duchek et al., 2007; Roy et al., 2016; Stephan et al., 2018; Strickhouser and Sutin, 2021; Terracciano et al., 2013; Terracciano et al., 2017; Williams et al., 2013; Wilson et al., 2007; Yoneda et al., 2020; 2022).

Other studies were conducted in different countries from Europe, such as Switzerland (Donati et al., 2013; Rodriguez et al., 2016), England (Aschwanden et al., 2020b), Italy (Bessi et al., 2018; Terracciano et al., 2022; Terracciano et al., 2023), Germany (Kuzma et al., 2011) Austria (Berger-Sieczkowski et al., 2019) and France (Rouch et al., 2019). A study used an Australian cohort (Aschwanden et al., 2020b). Finally, only a study was conducted in Japan (Nishita et al., 2016). Demographic details can be found in the proper sections of Tables 1, 2, and 3.

3.2. Diagnostic criteria

According to inclusion criteria, studies reported different types of cognitive impairment diagnoses. In cross-sectional studies, diagnostic criteria enabled to divide the sample into healthy controls and individuals with prodromal or mild stages of cognitive impairment – i.e., MCI (Berger-Sieczkowski et al., 2019; Donati et al., 2013; Roy et al., 2016), mild (m-DAT) and very mild dementia of Alzheimer's type (vm-DAT; Duchek et al., 2007), probable and possible AD (Roy et al., 2016).

In longitudinal studies, diagnosis was made at baseline (T1) in order to assess the presence of cognitive decline and eventually exclude participants with a diagnosis of MCI or dementia if it was an exclusion criterion to be recruited into the study; then, cognitive status was assessed at the follow-up as a primary outcome and different types of diagnosis were made. In these studies, mild forms of cognitive impairment were the following: cognitive impairment without dementia (CIND; Aschwanden et al., 2020; Strickhouser and Sutin, 2021; Terracciano et al., 2017), MCI in both its amnestic and not-amnestic subtypes (Ayers et al., 2020; Yoneda et al., 2020) or unspecified (Bessi et al., 2018; Kuzma et al., 2011; Rodriguez et al., 2016; Wilson et al., 2007; Yoneda et al., 2022).

Finally, three longitudinal studies assessed personality trait changes in individuals who progressed to MCI.

Various criteria and screening tools were used to assess cognitive decline. The methods used to diagnose dementia, MCI, and cognitive impairment are described below.

3.2.1. Diagnosis of dementia

Different diagnoses of dementia were made in the selected studies. Four studies specified the diagnosis of Alzheimer's disease (AD) (Dar-Nimrod et al., 2012; Duberstein et al., 2011; Terracciano et al., 2013; Wilson et al., 2007); in two studies, AD was diagnosed according to the Diagnostic and Statistical Manual of Mental Disorders - Fourth Version (DSM-IV) criteria (American Psychiatric Association, 1994) after completion of neuropsychological batteries (Duberstein et al., 2011; Dar-Nimrod et al., 2012), and the type of dementia was assessed according to the National Institute of Neurological and Communication Disorders and Stroke, Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA; McKhann et al., 1984) criteria; a study

Table 2
Longitudinal studies. Personality traits and risk for cognitive impairment.

Author (year)	Country (study cohort)	Sample size (F/M) at T1	Mean age (SD), range at T1	T1-T2	Personality assessment	Cognitive measurement	Criteria for MCI/ dementia diagnosis	Control variables (covariates)	Results
Aschwanden et al. (2020b)	England (English Longitudinal Study of Aging: *ELSA*) Australia (The Household Income and Labour Dynamics in Australia: *HILDA*)	*ELSA:* 6887 (56.20 %/ 43.80 %) *HILDA:* 2778 (54.60 %/ 45.40 %)	*ELSA:* 65.65 (8.31), 50–89. *HILDA:* 60.90 (8.08), 50–88	*ELSA:* T1: 2010 (wave 5) T2: 2014/ 2015 (wave 7) and 2016/ 2017 (wave 8) *HILDA:* *T1:* 2005/ 2006 (wave 5) T2: 2012/ 2013 (wave 12) and 2016/ 2017 (wave 16)	*ELSA:* MIDI (T1) *HILDA:* Saucier's Mini-Markers (T1)	*ELSA:* (T1 and T2) immediate and delayed word list recall test, serial 7 subtraction, and backward counting (from TICSm) *HILDA:* (T1 and T2) National Adult Reading Test (NART), Symbol Digit Modalities Test (SDMT) and Backwards Digit Span (BDS).	*ELSA:* self-reported dementia/ TICSm scores (12–27: normal; 7–11 CIND; dementia ≤6) *HILDA:* dementia as ≥1.5 SD below the age- and education-adjusted mean on SDMT and BDS.	Age, gender, ethnicity, origin (covariates)	*ELSA:* higher N associated with increased risk of dementia; higher C and E related to decreased risk. Higher O tended to be more protective for young-old adults (<65.65 years). *HILDA:* higher N associated with increased risk of dementia. Higher A associated to decreased risk; higher A more protective for women.
Ayers et al. (2020)	USA (Central Control of Mobility in Aging: *CCMA*)	524 (61.5 %/ 38.5 %)	76.5 (6.5)	3.0 (2.0)	BFI (T1)	Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)	a- and na-MCI: 1.5 SD below age and education adjusted norms on relevant cognitive tests (DSM-IV) Dementia: DSM-IV	Age, sex, ethnicity, education, multi-morbidity index score	N associated with increased risk of na-MCI.
Bessi et al. (2018)	Italy	212 (66 %/34 %) SCD-stable: 68 (44/24) SCD-progressive: 26 (19/7) SCD-converted: 15 (11/4) MCI-stable: 64 (41/22) MCI-converted: 39 (26/13)	SCD-s: 64.45 (6.63) SCD-p: 63.80 (8.85) SCD-c: 66.91 (5.75) MCI-stable: 67.21 (7.03) MCI-c: 71.97 (5.12)	SCD: 7.15 (3.88) MCI: 7.51 (4.78)	Big Five Factor Questionnaire (T1)	Extensive neuropsychological battery	MCI and AD: NIA-AA criteria. SCD: Subjective Cognitive Decline Initiative (SCD-I) Working Group		Higher Emotional Stability was related to higher risk of progression from SCD to MCI.
Dar-Nimrod et al. (2012)	USA (Ginko Evaluation of Memory: *GEM)*	602 (41.4 %/ 58.6 %)	78.6 (3.1), 72–91.	7.3 (6.1)	NEO-FFI (T1)	Cognitive subscale of the Alzheimer Disease Association (ADAS-cog)	AD Dementia: DSM-IV. Classification of dementia type: NINCDS-ADRDA; NINDS-AIREN, ADDTC.	Age, gender, ethnicity, education, self-rated health, self-reported pathologies	High levels of both N and E moderated the APOE4-ADAS association over the follow-up period. Incidence of AD in the presence of APOE4 higher for individuals with high Neuroticism as well as high Extraversion.
Duberstein et al. (2011)	USA (*GEM*)	767 (41.2 %/ 58.1 %)	78.6 (3.1)	7.3 (6.1)	NEO-FFI (T1)	Cognitive subscale of the Alzheimer Disease Association (ADAS-cog)	AD Dementia: DSM-IV. Classification of dementia type: NINCDS-ADRDA; NINDS-AIREN, ADDTC	Age, gender, ethnicity, education, self-rated health, self-reported pathologies, 3MSE.	High Neuroticism and low Openness and Conscientiousness were associated to an increased risk of AD. O and C were no longer significant in the presence of other traits.

(*continued on next page*)

Table 2 (*continued*)

Author (year)	Country (study cohort)	Sample size (F/M) at T1	Mean age (SD), range at T1	T1-T2	Personality assessment	Cognitive measurement	Criteria for MCI/dementia diagnosis	Control variables (covariates)	Results
Kuzma et al. (2011)	Germany (German Interdisciplinary Longitudinal Study on Adult Development and Aging: ILSE)	221 (49 %/51 %) Healthy: 156 (81/75) MCI: 66 (28/38)	Healthy: 74.10 (1.13) MCI: 74.32 (1.07)	12 years (1 per year)	German version of the NEO-FFI	Neuropsychological battery	MCI: ageing-associated cognitive decline criteria	Education and gender	Higher risk for developing MCI for those higher in N.
Nishita et al. (2016)	Japan (National Institute for Longevitiy Sciences – Longitudinal Study of Aging (NILS-LSA)	594 (48 %/52 %)	68.23 (5.63)	8.01	NEO-FFI (T1)	Japanese Version of MMSE	Cognitive decline: MMSE score $\leq$ 27. Severe cognitive decline: MMSE score $\geq$ 24 and $\leq$ 27.	Education level, marital status, occupation, current smoking, depressive symptoms, BMI, leisure time physical activities, blood pressure, levels of glucose, cholesterol and triglyceride.	Higher O was associated with reduced risk for cognitive decline. Higher C predicted lower risk for severe cognitive decline.
Rodriguez et al. (2016)	Switzerland	590 (57 %/43 %) Stable-controls (s-CON): 264 (160/ 104) Deteriorating-controls (d-CON): 224 (137/87) MCI: 102 (37/65)	s-CON: 71.56 (4.35)d -CON: 73.12 (4.82) MCI: 71.78 (6.06)	18 months.	NEO-PI-R	Extensive neuropsychological battery	MCI: Petersen's criteria. Dementia: DSM-IV	Age, sex, educational level	O differed between s-CON and the other two groups and was associated with a risk reduction of being in the d-CON and MCI groups
Stephan et al. (2018)	USA (Health and Retirement Study: *HRS)*	7340 (58 %/42 %)	67.90 (9.39)	4	MIDI	TICSm	Cognitively impaired: TICSm scores < 11		N and C mediated the association between polygenic risk of AD and decline in cognition.
Strickhouser and Sutin (2021)	USA (Health and Retirement Study: *HRS)*	9899 (58.97 %/41.03 %)	65.78 (10.13)	Every 2 years for 10 years (4 or 5 waves)	MIDI	TICSm	TICSm scores. Cognitively normal: 12–27. Cognitively impaired non dementia (CIND): 7–11. Dementia: 0–6	Demographics, Health status and retirement status	Higher N was associated to higher risk for dementia and CIND. Higher C associated with lower risk of dementia and CIND. Higher O associated with lower risk for CIND.
Terracciano et al. (2013)	USA (Baltimore Longitudinal Study of Aging: *BLSA)*	111 (32 %/68 %) Normal: 27 (3/24) Asymptomatic Alzheimer's disease (ASYMAD): 29 (9/20) Alzheimer's disease (AD): 55 (24/31)	Normal: 65.5 (13.4) ASYMAD: 72.3 (10.2) AD: 72.5 (11.0)		NEO-PI-R	Neuropsychological battery	AD Dementia: NINCDS-ADRDA and DSM-III-R		Higher N and lower C were related to higher risk for clinical AD.
Terracciano et al. (2017)	USA (*HRS)*	10457 (60 %/40 %)	67.17 (9.23), 50–89	6.29 (1.78), 2–8	MIDI	TICSm	TICSm scores. Cognitively normal: 12–27. Cognitively impaired	Age, sex, ethnicity, race, educational level	Higher N, lower C and A were associated independently with higher risk of incident dementia.

(*continued on next page*)

Table 2 (*continued*)

Author (year)	Country (study cohort)	Sample size (F/ M) at T1	Mean age (SD), range at T1	T1-T2	Personality assessment	Cognitive measurement	Criteria for MCI/ dementia diagnosis	Control variables (covariates)	Results
							non dementia (CIND): 7–11. Dementia: 0–6		High N and low C were associated with greater risk of incident CIND. Lower C was a significant predictor of conversion from CIND to dementia.
Terracciano et al. (2022)	Italy	1668 (56.4 %/ 43.6 %)	61.48 (8), 50–93.7	10.38 (4.76)	NEO-PI-R	MMSE	Cognitive impairment: MMSE score < 24	Age, sex, education, smoking status, hypertension, diabetes, depression	Higher N and lower C were risk factors for cognitive impairment. Higher O and A were protective.
Williams et al. (2013)	USA	51 (65 %/ 35 %)	69.53 (6.37), 58–87	1.4 (7 months – 1.4)	NEO-PI-R	Mattis Dementia Rating Scale (DRS−2)	Cognitive decline: DRS−2		O was associated with cognitive declne
Wilson et al. (2007)	USA (Religious Orders Study: *ROS)*	939	Healthy: 728 (68 %/ 32 %) Incident AD: (71 %/ 29 %)	12 (one per year)	NEO-FFI	Extensive neuropsychological battery	MCI and AD dementia: previously by a neuropsychologist (after reviewing results on cognitive tests)	Sex, age, education and depressive symptoms	Higher C associated with reduced risk of both MCI and AD.
Yoneda et al. (2020)	USA (Einstein Aging Study: *EAS)*	785 (42 %/ 58 %) Healthy: 602 (214/388) MCI: 135 (70/65) Dementia: 48 (24/24)	Healthy: 77.36 (4.8) MCI: 79.29 (5.17) Dementia: 80.23 (5.27)		IPIP	MMSE. Neuropsychological battery	Dementia: DSM-IV. MCI: a-MCI and na-MCI < 1.5 SD below on one of several cognitive domains		Increases in N preceding dementia and MCI.
Yoneda et al. (2022)	USA (Rush Memory and Aging Project: *MAP)*	1954 (74 %/ 26 %)	79.93 (7.57), 53.35–100.47		NEO-FFI	Neuropsychological battery	Dementia and MCI: NINCDS-ADRDA	Age, education, sex, APOE e3	Higher C associated with decreased risk of transition from NCI to MCI. Higher N associated with higher risk of transition from NCI to MCI and decreased likelihood of transition from MCI back to NCI. Higher E associated with higher likelihood of transition from MCI to NCI.

T1: baseline; T2: follow-up; SD: standard deviation; SCD: Subjective Cognitive Decline; MCI: Mild Cognitive Impairment; a-MCI: amnestic Mild Cognitive Impairment; na-MCI: non-amnestic Mild Cognitive Impairment; CIND: Cognitive Impairment Not Dementia; AD: Alzheimer's Disease; MIDI: Midlife Development Inventory; BFI: Big Five Inventory; NEO-FFI: NEO Five-Factor Inventory; NEO-PI-R: NEO Personality Inventory Revised; IPIP: International Personality Item Pool; TICSm: Telephone Interview for Cognitive Status; MMSE: Mini-Mental State Examination; NIA-AA: National Institute on Aging and Alzheimer's Association; NINCDS-ADRDA: National Institute of Neurological and Communicative Disorders and Stroke and Alzheimer's Disease and Related Disorders Association; NINDS-AIREN: Association Internationale pour la Recherche et l'Enseignement en Neurosciences; ADDTC: Alzheimer's Disease Diagnostic and Treatment Centers; DSM-V: Diagnostic and Statistical Manual of Mental Disorders Fifth Edition; N: Neuroticism; E: Extraversion; O: Openness; C: Conscientiousness; A: Agreeableness.

Table 3
Longitudinal studies. Changes in personality across cognitive status.

Author (year)	Country (study cohort)	Sample size (F/M) at T1	Mean age (SD), range at T1	Personality assessment method	Cognitive measurement	Criteria for MCI/dementia diagnosis	Results
Caselli et al. (2016)	USA	MCI transitioners: 25 (13/12) MCI non transitioners: 252 (175/77)	MCI-t: 65.5 MCI-nt: 62.7	NEO-PI-R	Neuropsychological battery	MCI: NIA-AA	Increased N and decreased O in MCI-t compared to MCI-nt.
Kuzma et al. (2011)	Germany (German Interdisciplinary Longitudinal Study on Adult Development and Aging: ILSE)	Healthy: 156 (81/75) MCI: 66 (28/38)	Healthy: 74.10 (1.13) MCI: 74.32 (1.07)	German version of the NEO-FFI	Neuropsychological battery	MCI: ageing-associated cognitive decline criteria	E and N decreased from T1 and T2. In T1, MCI had higher N and O compared to healthy controls. Higher risk for developing MCI for those higher in N.
Terracciano et al. (2023)	USA (Health and Retirement Study: HRS)	22611 (13202/9409)	64.79 (10.40), 50–104	MIDI	TICSm	Cognitive impairment: TICSm scores ≤11	N increased during cognitive impairment. O declined during cognitive impairment. E, A and C decreased both before and during cognitive impairment.

SD: standard deviation; T1: baseline; T2: follow-up; MCI: Mild Cognitive Impairment; NEO-PI-R: NEO Personality Inventory Revised; NEO-FFI: NEO Five Factor Inventory; Midlife Development Inventory; TICSm: Telephone Interview for Cognitive Status; NIA-AA: National Institute on Aging and Alzheimer's Association; N: Neuroticism; O: Openness; E: Extraversion; A: Agreeableness; C: Conscientiousness.

conducted by Terracciano et al. (2013) considered the diagnostic criteria expressed in the Third Revised version of the DSM (DSM-III-R; American Psychiatric Association, 1987); one study (Bessi et al., 2018) made the diagnosis of AD according to the National Institute on Aging-Alzheimer's Association (NIA-AA; Sperling et al., 2011) criteria. Furthermore, one study (Yoneda et al., 2022) made a diagnosis of probable Alzheimer's disease and related dementias if there was evidence of a significant decline in cognitive functioning with impairment in memory and at least one additional cognitive domain according to the NINCDS-ADRDA criteria. In this study, dementia type was assessed according to the criteria developed by the NINCDS-ADRDA, the National Institute of Neurological Disorders and Stroke and the Association Internationale pour la Recherche et l'Enseignement en Neurosciences (NINDS-AIREN; Van Straaten et al., 2003), and the Alzheimer's Disease Diagnostic and Treatment Centers (ADDTC). Two studies defined two stages of AD dementia: prodromal AD (Rouch et al., 2019) or very-mild AD (Duchek et al., 2007) according to the Washington University CDR scale (=0.5); mild AD according to NINCDS-ADRDA (Rouch et al., 2019) criteria and the Clinical Dementia Rating (CDR) score =1 (Duchek et al., 2007).

The majority of the studies (Rodriguez et al., 2016; Ayers et al., 2020; Yoneda et al., 2020; Strickhouser and Sutin, 2021; Terracciano et al., 2017; Aschwanden et al., 2020; Terracciano et al., 2022) did not specify the type of dementia. In three of these studies (Rodriguez et al., 2016; Ayers et al., 2020; Yoneda et al., 2020), the diagnosis was made according to the DSM-IV criteria (American Psychiatric Association, 1994) after completing neuropsychological batteries. Three studies classified participants as having dementia (Strickhouser and Sutin, 2021; Terracciano et al., 2017; Aschwanden et al., 2020) based on their scores (<6) on the Telephone Interview for Cognitive Status (TICSm). A study (Terracciano et al., 2022) used the Kochhann and colleagues' education-adjusted cut-offs (Kochhann et al., 2010) on the Mini-Mental State Examination (MMSE; Folstein et al., 1975); accordingly, dementia was diagnosed based on schooling as follows: up to elementary school, MMSE scores lower than 21; junior high, MMSE scores lower than 22; high school, MMSE scores lower than 23; university degree, MMSE scores lower than 24.

3.2.2. MCI

Two studies considered the NIA-AA criteria (Albert et al., 2011) for the diagnosis of MCI (Caselli et al., 2016; Bessi et al., 2018). MCI was assessed according to Petersen's criteria in three studies (Rodriguez et al., (2016); Berger-Sieczkowski et al., (2019); Roy et al., (2016). One study diagnosed MCI according to the DSM-IV (Ayers et al., 2020), while another study used Winblad's criteria for MCI diagnosis by a study (Donati et al., 2013). Yoneda et al. (2022) diagnosed MCI according to the National Institute of Neurological and Communication Disorders and Stroke, Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA; McKhann et al., 1984) criteria.

3.2.3. Cognitive impairment

Other forms of cognitive impairment were diagnosed. Three studies diagnosed cognitive impairment without dementia (CIND) using the Telephone Interview for Cognitive Status (TICSm) scores (7−11) (Aschwanden et al., 2020; Strickhouser and Sutin, 2021; Terracciano et al., 2017). Stephan et al. (2018) diagnosed cognitive impairment with a TICSm score of 11. However, none of the studies indicated a diagnosis of dementia or MCI. Finally, another study considered a score below 27 on the Mini Mental State Examination indicative of cognitive decline (Nishita et al., 2016).

3.3. Personality assessment

Personality was assessed using different questionnaires based on the Five Factors Model (McCrae and Costa, 1997). Seven studies used the NEO-PI-R (Costa and McCrae, 1992) in its original version (Wilson et al., 2007; Terracciano et al., 2013; Williams et al., 2013; Rodriguez et al., 2016; Caselli et al., 2016; Terracciano et al., 2022; Rouch et al., 2019), and in its Italian version (Terracciano et al., 2022). The NEO-PI-R is a self-report questionnaire consisting of 240 items. It is designed to measure 30 facets of personality, with 6 facets for each major personality trait. Responses are expressed on a 5-point Likert scale.

Seven studies used the NEO-Five Factor Inventory (NEO-FFI) (Roy et al., 2016; Duchek et al., 2007). It is a 60-item self-report questionnaire that measures five factors, with 12 items for each factor; responses are given on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree". Two of the five studies mentioned above (Duberstein et al., 2011; Dar-Nimrod et al., 2012) used data and participants from the same cohort study (GEM). The NEO-FFI was also used in its Japanese version (Nishita et al., 2016) and German version (Kuzma et al., 2011).

Three studies (Terracciano et al., 2017; Stephan et al., 2018; Strickhouser and Sutin, 2021) assessed personality traits using data from the same cohort study (Health and Retirement Study: HRS). Another study (Aschwanden et al., 2020), examining the sample from ELSA, assessed personality through the Midlife Development Inventory (MIDI). This questionnaire includes 26 adjectives (neuroticism: 4 items; extraversion: 5 items; openness: 7 items; agreeableness: 5 items; conscientiousness: 5 items). Participants must rate their degree of agreement with each adjective on a Likert-type scale ranging from 1 (*not at all*) to 4 (*a lot*).

A study (Aschwanden et al., 2020) used a limited subtest of Saucier's Mini-Markers (Saucier, 1994), which includes 28 items (4 for agreeableness and 6 for each remaining traits), while the original version of the test consists of 36 items. Responses are expressed on a Likert-type scale ranging from 1 ("*does not describe me at all*") to 7 ("*describes me very well*").

One study (Ayers et al., 2020) used the Big Five Inventory (BFI: (John et al., 1991) to measure five personality traits. The BFI consists of 44 self-report items rated on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Each trait is scored from 0 to 40 for each trait. Each trait is scored from 0 to 40.

A study (Bessi et al., 2018) assessed personality through the Big Five Factor Questionnaire. This questionnaire replaces 'neuroticism' and 'extraversion' with "emotional stability" and "energy", respectively. Each factor is assessed by 24 items with responses given on a 5-point scale, ranging from "strongly agree" to "strongly disagree".

Yoneda et al. (2020) used the International Personality Item Pool (IPIP) to evaluate personality (Goldberg et al., 2006). The assessment of each trait involves 10 items with five response options ranging from 1 (very inaccurate) to 5 (very accurate). To obtain the final score for each trait, a mean score is computed; scores can range from 1 to 5 according to the endorsement for that trait.

3.4. Cross-sectional studies (N=5)

Table 1 summarizes the results of five cross-sectional studies included in this review. These studies assessed personality differences between healthy participants and individuals with both MCI (Berger-Sieczkowski et al., 2019; Donati et al., 2013; Roy et al., 2016) and mild AD (Duchek et al., 2007; Rouch et al., 2019; Roy et al., 2016).

Openness was found to be lower in individuals with MCI (Donati et al., 2013; Roy et al., 2016) and those with very mild dementia of the AD-type (Duchek et al., 2007) compared to controls. Specifically, Berger-Sieczkowski et al. (2019) found lower levels of Openness in individuals with amnestic MCI compared to those with non-amnestic MCI.

Lower Extraversion in individuals with MCI compared to controls was found in two studies (Berger-Sieczkowski et al., 2019; Donati et al., 2013).

Other two studies found higher levels of Neuroticism in individuals with MCI (Donati et al., 2013) and those with mild AD-type dementia (Duchek et al., 2007) compared to controls.

Only one study (Berger-Sieczkowski et al., 2019) found lower Conscientiousness in individuals with amnestic MCI compared to controls.

No significant results were found regarding Agreeableness. In one study (Rouch et al., 2019), no differences between groups were observed.

3.5. Longitudinal studies – The role of personality traits on risk for cognitive decline (N=17)

Seventeen longitudinal studies met the inclusion criteria and investigated the influence of the Big five traits on the risk for MCI and dementia. The results are summarized in Table 2.

3.5.1. Neuroticism

The majority of the included studies highlighted a significant association between the Neuroticism trait and the risk for MCI and dementia. Higher levels of Neuroticism have been associated with an increased risk of developing dementia (Aschwanden et al., 2020; Strickhouser and Sutin, 2021; Terracciano et al., 2017), particularly an AD-type (Duberstein et al., 2011; Terracciano et al., 2013).

Higher levels of Neuroticism have also been associated with an increased risk for MCI (Kuzma et al., 2011; Ayers et al., 2020) and cognitive impairment (Terracciano et al., 2017, 2022).

Furthermore, the results suggest that Neuroticism may negatively impact on cognitive functioning. Specifically, higher levels of this trait have been associated with an increased risk of progression from subjective cognitive decline to MCI (Bessi et al., 2018) and from normal cognition to MCI (Yoneda et al., 2022).

Dar-Nimrod et al. (2012) found that the presence of APOE4 was associated with cognitive functioning in the follow-up period and that this association was moderated by higher levels of Neuroticism. Furthermore, individuals with higher levels of Neuroticism who were APOE 4 careers were also more likely to develop AD.

Similarly, Stephan et al. (2018) found that higher levels of Neuroticism increase the risk of cognitive decline in individuals with a higher polygenic risk of AD.

Finally, four studies (Nishita et al., 2016; Williams et al., 2013; Wilson et al., 2007; Rodriguez et al., 2016) did not find an association between Neuroticism and the risk of cognitive decline, both moderate and severe.

3.5.2. Extraversion

Most of the selected studies did not indicate a significant role of Extraversion in the risk for MCI and dementia (see Table 2). However, Aschwanden et al. (2020b) found that higher levels of Extraversion were associated with a lower risk of developing dementia. Similarly, higher levels of Extraversion have been found to have a higher likelihood of transition from MCI to normal cognition (Yoneda et al., 2022).

In contrast to these findings, a study discovered that the incidence of AD was higher for individuals with higher levels of Extraversion in the presence of APOE 4 (Dar-Nimrod et al., 2012).

3.5.3. Openness

Several studies have failed to find a relationship between Openness and the risk for cognitive decline or dementia (Ayers et al., 2020; Bessi et al., 2018; Dar-Nimrod et al., 2012; Stephan et al., 2018; Terracciano et al., 2013; Terracciano et al., 2017; Wilson et al., 2007; Yoneda et al., 2022; Kuzma et al., 2011)

However, all remaining studies consistently indicated that higher levels of the Openness trait are protective against the risk of cognitive decline.

Specifically, higher Openness has been found to protect against the risk of dementia (Aschwanden et al., 2020; Terracciano et al., 2022) and cognitive decline (Nishita et al., 2016; Strickhouser and Sutin, 2021; Williams et al., 2013), including MCI (Rodriguez et al., 2016). Similarly, a lower level of Openness was associated with a higher risk of AD (Duberstein et al., 2011). However, this association was no longer significant when other traits, such as Neuroticism, were taken into account.

3.5.4. Conscientiousness

The results indicate that higher levels of Conscientiousness have a protective effect against cognitive decline and risk for dementia (Aschwanden et al., 2020; Nishita et al., 2016; Strickhouser and Sutin, 2021), AD dementia (Wilson et al., 2007), MCI (Wilson et al., 2007; Yoneda et al., 2022) and moderate cognitive decline (Strickhouser and Sutin, 2021; Terracciano et al., 2017, 2022).

Lower levels of Conscientiousness were also found to be associated with an increased risk of AD (Duberstein et al., 2011; Terracciano et al., 2013). However, Duberstein et al. (2011) found that this association was

no longer significant when considering other traits.

Furthermore, Conscientiousness mediated the association between the polygenic risk of AD and a decline in cognition (Stephan et al., 2018).

Only a few studies did not find a relationship between Conscientiousness and the risk for cognitive decline (Ayers et al., 2020; Kuzma et al., 2011; Bessi et al., 2018; Dar-Nimrod et al., 2012; Rodriguez et al., 2016; Williams et al., 2013).

3.5.5. Agreeableness

Most studies did not find any effects of Agreeableness on the risk for cognitive decline. However, two studies reported that higher Agreeableness was associated with a reduced risk of dementia (Aschwanden et al., 2020) and cognitive impairment (Terracciano et al., 2022). Similarly, Terracciano et al. (2017) found that lower Agreeableness was associated with a higher risk of dementia.

3.6. Longitudinal studies – Changes in personality across different cognitive statuses (N=3)

Only three studies investigated all the five factors longitudinally across stages of cognitive decline. Caselli et al. (2016) found an increase in Neuroticism and a decrease in Openness levels in participants who developed MCI compared to those who did not develop a preclinical form of dementia. Similarly, Terracciano et al. (2023) observed a significant increase in Neuroticism and a significant decrease in the other four personality traits during cognitive impairment. However, only Extraversion, Conscientiousness, and Agreeableness started to decline before the cognitive impairment.

On the other hand, Kuzma et al. (2011) conducted a study on the German population and revealed a decrease in levels of neuroticism and extraversion over time. The results are presented in Table 3.

All the results about the relationship between personality and cognitive decline are summarized in Table 4.

4. General discussion

This systematic review provides a comprehensive examination of the relationship between personality traits and cognitive decline, offering insights from two different perspectives: on the one hand, the main research question was how personality traits could differently influence cognitive decline (i.e., MCI, dementia); the second aim of this work was to understand whether individuals with different cognitive status (i.e., healthy, MCI, dementia) exhibit different levels of personality traits.

By synthesizing findings from longitudinal studies, this review contributes to understanding how personality traits influence the risk of preclinical forms of cognitive decline (i.e., MCI, CIND) and dementia (e.g., AD, non-specified dementia).

Personality traits have received increasing attention in research on cognitive aging. The findings indicate that personality traits may remain relatively stable throughout the lifespan, but change can occur in older adulthood, especially in cases of moderate to severe cognitive decline. This review examines variations in personality traits across different cognitive conditions, including normal cognition, MCI, and CIND in both cross-sectional and longitudinal studies.

The investigation of the impact of the Big Five on cognitive decline has received increased attention in the last decade, as evidenced by the growing number of systematic reviews (Low et al., 2013) and meta-analyses (Aschwanden et al., 2021) published in recent years. This attention may be due to an increasing awareness of the key role that personality plays in influencing cognition, both directly (e.g., specific autonomic or cortical activation) and indirectly (e.g., healthy or risky behaviors). It is crucial to consider methodological factors interpreting the results of this review.

Recent studies (e.g., Aschwanden et al., 2021) have primarily focused on data from the USA. However, this review broadened its scope

Table 4
Summary table about the relationship between personality traits and cognitive decline.

Personality Trait	Risk for MCI	Risk for moderate impairment and dementia	Cognitive impairment vs. healthy
Neuroticism	↑Kuzma et al., (2011) ↑Ayers et al., (2020) ↑Terracciano et al., (2017), (2022) ↑Bessi et al., (2018)	↑ Aschwanden et al. (2020b) ↑ Strickhouser and Sutin, (2021) ↑ Terracciano et al., (2017) ↑ Duberstein et al., (2011) ↑ Terracciano et al., (2013)	↑ levels in MCI Donati et al., (2013) ↑ levels in vm-DAT Duchek et al., (2007) ↑ levels in MCI Kuzma et al., (2011)
	No results: Nishita et al., (2016); Williams et al., (2013); Wilson et al., (2007); Rodriguez et al., (2016)		
Extraversion	↓ Aschwanden et al. (2020b) ↓ Yoneda et al., (2022)	↑ Dar-Nimrod et al., (2012)	↓ levels in MCI Berger-Sieczkowski et al., (2019) ↓ levels in MCI Donati et al. (2013)
	No results: Ayers et al., (2020); Bessi et al., (2018); Duberstein et al., (2011); Kuzma et al., (2011); Nishita et al., (2016); Rodriguez et al., (2016); Stephan et al., (2018); Strickerhouser and Sutin, 2021; Terracciano et al., (2013), (2017), (2022); Williams et al., (2013); Yoneda et al., (2020)		
Openness	↓ Nishita et al., (2016) ↓ Strickhouser and Sutin, (2021) ↓ Williams et al., (2013) ↓ Rodriguez et al., (2016)	↓ Aschwanden et al. (2020b) ↓ Duberstein et al., (2011) ↓ Terracciano et al., (2022)	↓ levels in MCI Berger-Sieczkowski et al., (2019) ↓ levels in MCI Donati et al., (2013) ↓ levels in MCI Kuzma et al., (2011) ↓ levels in m-DAT and vm-DAT Duchek et al. (2007) ↓ levels in MCI, probable AD and possible AD Roy et al., (2016)
	No results: Ayers et al., (2020); Bessi et al., (2018); Dar-Nimrod et al., (2012); Stephan et al., (2018); Terracciano et al., (2013); Terracciano et al., (2017); Wilson et al., (2007); Yoneda et al., (2022); Kuzma et al., (2011)		
Conscientiousness	↓Wilson et al., (2007); ↓ Yoneda et al., (2022)	↓ Aschwanden et al. (2020b) ↓Nishita et al., (2016); ↓ Strickhouser and Sutin, (2021) ↓Wilson et al., (2007)	↓ levels in MCI Berger-Sieczkowski et al., (2019)
	No results: Ayers et al., (2020); Kuzma et al., (2011); Bessi et al., (2018); Dar-Nimrod et al., (2012); Rodriguez et al., (2016); Williams et al., (2013)		
Agreeableness	↓ Terracciano et al., (2022)	↓ Aschwanden et al. (2020b) ↓ Terracciano et al., (2017)	-
	No results: Ayers et al., (2020); Bessi et al., (2018); Dar-Nimrod et al., (2012); Duberstein et al., (2011); Kuzma et al., (2011); Nishita et al. (2016); Rodriguez et al., (2016); Stephan et al., (2018); Terracciano et al. (2013); Wilson et al., (2007); Yoneda et al., (2020), (2022).		

Table 4. MCI: Mild Cognitive Impairment; m-DAT: mild dementia of Alzheimer's type; vm-DAT: very mild dementia of Alzheimer's type; AD: Alzheimer's Disease; ↓: lower; ↑: higher.

to include studies from various parts of the world, providing important insights into how personality traits influence cognitive decline across different cultures and languages. Previous research (Davey et al., 2015) has shown a high level of agreement in findings regarding the role of personality in the risk for preclinical (i.e., MCI, CIND) and frank dementia across different countries.

Moreover, previous reviews (Low et al., 2013) have included studies relying on informant-based personality reports. These reports are provided by relatives and partners who describe the premorbid personality of individuals with dementia. However, there are concerns regarding the accuracy of these assessments and the potential introduction of biases due to the potential discrepancy between self and informant-rated personality traits (Terracciano and Sutin, 2019). On the other side, self-report personality measures have shown greater reliability and validity, particularly among individuals with MCI. For this reason, to mitigate potential biases, this review only included studies that used self-report measures of personality from healthy individuals and participants who were classified as MCI or not demented. In longitudinal studies, personality was assessed at baseline, when participants were free from cognitive impairment, in order to accurately assess the influence of pre-morbid personality on the risk for MCI and dementia in the follow-up period.

Finally, the review aimed to systematically summarize results and obtain more precise information about the overall influence of Big Five personality traits on cognitive decline and changes in personality in the pre-clinical forms of dementia by selecting studies that investigated all personality traits. These methodological choices resulted in consistent findings regarding the influence of personality traits, which are discussed below.

4.1. The effects of personality on risk for MCI and dementia

The most robust and consistent finding of this systematic review concerns the role of Neuroticism as a risk factor for both MCI and dementia. This underscores the significance of this trait in predisposing individuals to cognitive decline. Neuroticism has been associated with neurodegeneration biomarkers and the pathological aggregation of tau protein in neurofibrillary tangles, a hallmark of AD dementia (Aschwanden et al., 2021). Studies included in this review have reinforced this evidence by showing that Neuroticism can moderate the effects of the APOE4 allele on cognitive functioning (Dar-Nimrod et al., 2012; Donati et al., 2013). Interestingly, low levels of neuroticism seem to protect against cognitive decline, even in the presence of genetic risk factors, leading to the preservation of normal daily functioning.

These findings can be explained from two perspectives: behavioral and physiological aspects. From a behavioral perspective, individuals with higher levels of Neuroticism tend to experience stress, anxiety, and emotional instability. These factors are often associated with risky behaviors, such as smoking, alcohol consumption, and physical inactivity (Sutin et al., 2022; Aschwanden et al., 2021). These unhealthy habits and lifestyles may increase the risk of developing chronic conditions that compromise cognition. For example, physical inactivity and sedentary behavior heighten the risk of developing cardiovascular diseases (e.g., hypertension), which in turn increases the risk of cognitive impairment (Forte and Casagrande, 2020). In line with this view, a study conducted by Chan et al. (2018) observed that individuals who are agreeable, conscientious, and emotionally stable tend to be more capable of maintaining their subjective well-being through various ways, such as healthy lifestyles.

From a physiological point of view, the allostatic overload theory (McEwen, 1998) also provides compelling support for the association between Neuroticism and cognitive decline. Individuals with high Neuroticism may perceive neutral stimuli as threatening and struggle to manage environmental stressors, leading to chronic activation of the body's stress response systems, such as the HPA axis and the autonomic nervous system (ANS). Prolonged activation of these systems can disrupt the allostatic balance, resulting in dysregulated physiological responses characterized by hyper-arousal and overload, which ultimately contribute to cognitive impairment.

Given the stability of personality traits throughout one's lifespan, heightened levels of Neuroticism may perpetuate a maladaptive pattern of physiological responses. This, in turn, increases the risk of pathological cognitive decline, especially among individuals who are genetically predisposed to dementia, such as carriers of the APOE4 allele. Therefore, it is crucial to understand the complex interplay between Neuroticism, behavioral factors, and physiological mechanisms to develop targeted interventions aimed at mitigating the adverse effects of Neuroticism on cognitive health and reducing the overall burden of dementia in aging populations.

Behavioral and physiological factors also play a significant role in the case of Extraversion. Extraverted individuals exhibit socially and physically active lifestyles that are protective against chronic diseases and, ultimately, dementia (Wang et al., 2009). Moreover, from a physiological perspective, Extraversion is linked to lower resting blood pressure and a reduced risk of hypertension (Liang et al., 2022). Studies have shown that extraverted individuals cope effectively with psychological stress by utilizing adaptive strategies (Şahin and Çetin, 2017) and seeking support (Amirkhan et al., 1995). This ability to manage stress contrasts with Neuroticism, which hinders adaptive coping strategies and can lead to an unhealthy balance in response to environmental demands, thereby impeding successful aging.

Nevertheless, our review revealed inconsistent findings regarding Extraversion and its relationship to dementia and cognitive impairment. While some studies suggest that Extraversion may have a protective effect against dementia and cognitive decline, others observe contradictory results. In fact, many of the selected studies failed to highlight the influence of Extraversion on the risk for dementia or MCI. These inconsistencies highlight the complexity of the relationship between Extraversion and cognitive health. For example, Dar-Nimrod et al. (2012) found that Extraversion moderated the effect of the gene APOE4 on cognitive performance, highlighting worse cognition in those who were more extraverted. As the authors suggested, this result could be explained by the loss of social interactions that could occur in late adulthood (e.g. retirement, loss of the partner); evidence suggest that individuals with high levels of Extraversion may have a lower threshold of behavioral activation in response to social and environmental stimuli, which could result in an enduring pursuit of goals and positive affects (Mueller et al., 2014). In light of these findings, a significant reduction in social stimuli and social engagement could represent a detrimental change for particularly extraverted individuals in late adulthood.

Nevertheless, another line of research suggests that Extraversion can be a significant protective factor against cognitive decline. The behavioral aspects of Extraversion, which promote greater involvement in social activities and greater motivation to maintain relationships, may exert an indirect protective effect against the risk for developing pathological cognitive decline (Wang et al., 2009). This is achieved by enhancing social support and cognitive reserve. Furthermore, future lines of research in neuroscience may elucidate whether the relationship between Extraversion and cognitive decline can be explained by dopaminergic activity in specific brain structures. Several pieces of evidence from neuroimaging studies have highlighted a decrease of dopaminergic activity in various cortical areas, including the prefrontal cortex (PFC) – not only in Alzheimer's disease, but also in the earliest stages of the pathology (Martorana and Koch, 2014); the reduced dopaminergic activity in these areas could underlie different symptoms, including deficits in the executive functioning, apathy and reduced motivation in social activities. Conversely, higher dopamine levels at rest in the same brain areas have been related to higher levels of Extraversion in healthy individuals, suggesting that extraverted individuals could exhibit a more reactive and sensitive dopaminergic system (Depue and Collins, 1999; Wacker and Smillie, 2015). Nevertheless, despite numerous investigations, no definitive relationship between the dopaminergic

system and Extraversion has been established, leaving the scientific literature inconclusive and contradictory (Wacker and Smillie, 2015). Further investigations are needed to clarify whether an increased sensitivity of the dopaminergic system could be a protective factor against the deterioration of prefrontal cortices in order to determine the role of Extraversion in the development and progression of MCI and dementia. In the light of the aforementioned contrasting findings, future research should also consider the potential moderating influence of genetic factors (e.g., APOE4) and environmental factors (e.g., socio-economic status, level of education) on this relationship. Furthermore, it is important to investigate the potential interaction between extraversion and other personality traits. For example, Wang and colleagues (2009) found that individuals with high Extraversion and low Neuroticism had the lowest risk of dementia. This result emphasizes the need for a more comprehensive investigation into the interplay between extraversion and other personality traits.

The results of the systematic review also highlight the significant role of Conscientiousness as a protective factor against dementia and MCI in older populations. Both cross-sectional and longitudinal studies underscore the importance of this personality dimension in preserving cognitive health. Higher levels of Conscientiousness were found to be consistently associated with a lower risk of developing dementia, including AD, as well as a reduced likelihood of developing MCI. These findings support previous literature indicating that Conscientiousness plays a protective role in maintaining cognitive health in later life (Sutin et al., 2022).

The protective effect of Conscientiousness can be attributed to several factors. From a behavioral perspective, individuals with high levels of Conscientiousness are more likely to adopt healthy lifestyles, such as following a balanced diet, engaging in regular exercise, and adhering to healthy sleep habits. These lifestyle habits may reduce the risk of developing chronic diseases, which are in turn associated with an increased risk of dementia. Moreover, responsibility, which is a facet of this trait, may reflect an internal need to regulate behavior in order to be accountable to others and maintain social engagement (Sutin et al., 2022). This aspect of Conscentiousness can help manage stress and reduce the risk of dysregulation of allostatic mechanisms, thereby potentially mitigating the onset of dementia. Therefore, the interplay between Conscientiousness, healthy lifestyles, and social engagement may play a crucial role in protecting against dementia in aging populations.

Furthermore, the results of the present review suggest a protective role of Openness against MCI and dementia (e.g., Nishita et al., 2016). Specifically, individuals with higher Openness were less likely to develop dementia, including AD, and experience cognitive decline over time.

The relationship between Openness and cognitive health is partially mediated by factors such as social engagement and cognitive reserve. Openness, which is characterized by a tendency to seek novelty and engage in intellectually stimulating activities, fosters cognitive flexibility (Nishita et al., 2016). This cognitive flexibility enables individuals to effectively navigate various challenges and maintain cognitive function as they age. In particular, cognitive reserve, which includes educational attainment, work experience, and leisure activities, can help protect against cognitive decline and brain damage (Corbo et al., 2023; Iraniparast et al., 2022; Nelson et al., 2021). The consistent association between Openness and cognitive reserve highlights the potential importance of incorporating cognitively stimulating activities into daily routines throughout the lifespan.

Finally, the results regarding Agreeableness were inconsistent and scarce. Most of the selected studies did not show an association between Agreeableness and the risk for cognitive impairment. In fact, the mechanisms by which this trait could influence the risk for dementia are still unclear and not fully understood. This lack of understanding may be due to the paucity of studies investigating the main features of Agreeableness in comparison to other personality traits. Further research could better investigate different facets of this personality trait in order to understand its potential contribution to cognitive decline and, more generally, to mental health.

The aforementioned results all converge to highlight a core aspect of personality, namely the interplay between genetic predisposition and environmental influence in the manifestation of individual traits.

The expression of personality traits is influenced by a complex interplay between genetic and environmental factors. A growing body of evidence suggests that the relative contribution of these two components may undergo changes across the lifespan (e.g., Kandler, 2012). Specifically, studies have indicated that as individuals age, the heritability of personality traits tends to decline, while the impact of environmental factors tends to increase (Kandler and Zapko-Willmes, 2017).

Several studies conducted on twins highlighted that about 50 % of the variance in personality traits is accounted by genetic factors (e.g. Kandler et al., 2019). However, a significant proportion of the individual differences in personality traits are thought to be attributable to non-shared environmental effects, such as the physiological and biochemical effects activated by different environmental experiences (Kandler, 2012). Consequently, over time, personality traits may become increasingly influenced by life events.

A great amount of research has been interested in the stability of personality traits across the lifespan. In this field of study, the term “rank-order stability” is used to describe the test-retest correlation between different assessments which can be conceptualized as an index of individual stability over time (Bleidorn et al., 2021). Literature in this field provides substantial evidence that individual differences in personality traits are consistent over an extended period of time. However, lower levels of stability are observed during young adulthood (Bleidorn et al., 2021). This suggests a moderate stability over longer intervals, with the possibility of fluctuation and changes in personality traits throughout the lifespan.

The evidence presented here demonstrates that personality traits are not fixed and immutable characteristics that persist throughout an individual’s life. Rather, they are susceptible to modulation by a multitude of environmental factors. The primary finding of this study, namely the robust correlation between Neuroticism and an elevated risk of dementia, prompts us to reconsider the fixed nature of potential outcomes associated with high Neuroticism. As a result, it may now contemplate the possibility of developing tailored interventions capable of modulating the direct and indirect effects of this trait.

Furthermore, although the focus of this review is late adulthood, the findings and subsequent reflections indicate the potential utility of psycho-educational interventions across all age groups. Awareness of the impact that the early environment and life events have in modulating the effects of factors that are genetically determined could improve individuals’ coping strategies and influence life choices and behavior.

4.2. Differences in personality between healthy and pre-clinical populations

Cross-sectional studies have been included in order to examine differences in personality traits between healthy and pre-clinical populations (e.g., Donati et al., 2013; Duchek et al., 2007). It is worth noting that individuals with MCI have been found to provide more reliable reports of their personality compared to those with dementia, whose severe cognitive impairment may render their reports unreliable.

Consistent with findings from longitudinal studies, individuals with MCI exhibit higher levels of Neuroticism and lower levels of both Conscientiousness and Openness, compared to healthy aging individuals. These personality traits appear to play a crucial role as potential protective or risk factors for MCI. Furthermore, the two longitudinal studies (Caselli et al., 2016; Kuzma et al., 2011) that assessed changes in personality across cognitive stages suggest that these traits could change during the preclinical phase of dementia.

Nevertheless, given the paucity and inconsistency of the results, it remains uncertain whether personality traits can serve as an index of a prodromal stage of dementia or if they are influenced by its progression.

5. Limitations and further perspectives

Although the methodology and the selection of the articles were rigorously controlled, this work has some limitations. First, as reported in the results section, some studies have used data from the same cohort samples (e.g., Strickhouser and Sutin, 2021; Yoneda et al., 2020), which may have exacerbated the findings.

Furthermore, it is possible that significant findings regarding the relationship between each personality trait and cognitive impairment could have been excluded from the selection criteria, as all five traits were required to be investigated. This choice was made in order to reduce the heterogeneity of the results and, particularly, of the methods adopted to assess personality.

In addition, cognitive impairment and dementia were defined according to different criteria, which could have impacted the classification of participants and the results due to varying methods of assessing cognitive decline.

6. Conclusions

The investigation of the association between personality traits and cognitive decline provides valuable insights into the multifaceted nature of cognitive aging. This review examines the complex interplay between personality traits and the risk of cognitive impairment, particularly focusing on the Big Five personality model. The findings reveal a nuanced relationship between personality traits and the trajectory of cognitive decline.

Among the Big Five traits, Neuroticism emerges as a prominent risk factor for both mild cognitive impairment (MCI) and dementia. This highlights its crucial role in shaping cognitive health outcomes.

Moreover, the study reveals that Conscientiousness and Openess have a protective effect against the onset of dementia and moderate cognitive decline. However, even with this clear understanding, there are still notable differences and contradictions, especially regarding Agreeableness, where the evidence remains uncertain.

Moreover, based on our findings and existing knowledge, further research could investigate the physiological factors associated with each trait and their impact on cognitive impairment. Examining the physiological correlates of personality could provide insight into the mechanisms through which personality contributes to inter-individual differences in cognitive decline. Additionally, examining the collective influence of all five traits within the Big Five Model could provide a more comprehensive understanding of how personality shapes cognitive aging trajectories. By exploring these pathways, we can improve our understanding of how personality affects cognitive health. This can help us develop better interventions to prevent and manage cognitive decline in older adults.

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Declaration of Competing Interest

All authors have no conflict of interest to disclose.

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