





Do Personality Traits Influence the Association Between Depression and Dementia in Old Age?

Gerontology & Geriatric Medicine
Volume 8: 1–8
© The Author(s) 2022
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/23337214211068257
journals.sagepub.com/home/ggm


Adeleye A. Adaralegbe, MBBS, PhD¹ , Henry Egbuchiem, MD² ,
Oluwatomi Adeoti, MD, MPH³ , Khuzeman Abbasi, MD⁴ , Esther Ezeani, MD⁵,
Ngozi Jane-Frances Adaralegbe, MBBS, PhD¹, Abdulraheem Olaide Babarinde, MBBS⁶,
Maureen Boms, MBBS, MPH⁷, Chidiebube Nzeako, MD⁸, and Olumide Ayeni, MBBS⁹

Abstract

Depression and personality traits are independent predictors of dementia or cognitive impairment. Despite the well-established relationship between these two psychosocial factors and dementia, no research has been documented on how personality traits can influence dementia in older adults exhibiting depressive symptoms. This study explores the influence of personality traits on the association between change in depression and dementia in old age. A population-based longitudinal cohort study involving two waves of data collected 5 years apart, containing 2210 American older adults, from the National Social Life, Health, and Aging Project to explore if personality traits influence how change in depression predicts the development of dementia. We assessed these relationships while adjusting for sociodemographic characteristics. Change in depression increased the likelihood of dementia at T2 by 4.2% (AOR = 1.04, $p = 0.019$) in the co-variate adjusted model. Personality traits, overall, did not influence how depression predicts the development of dementia. However, agreeableness individually nullified the effect of depression on the development of dementia, whereas extraversion was the only personality trait that significantly predicted dementia. Prosocial behaviors should be promoted in old age as these appear to be protective. In addition, early life education and a strong social support can keep the depression–dementia spectrum at bay in old age.

Keywords

Alzheimer's/dementia, cognition, depression, psychiatry, gerontology

Introduction

Dementia is a common disorder among older adults and is associated with important risk factors such as older age, educational attainment, income, cardiovascular disorders, depression, and other chronic medical illnesses (Bellou et al., 2017; Campbell et al., 2013; Lopez & Kuller, 2019). Over the years, numerous studies have linked long-term depression to the subsequent development of dementia in old age (Byers & Yaffe, 2011; Valkanova et al., 2017; Yu et al., 2020). One of these studies noted that patients with early life depression or depressive symptoms exhibit more than a two-fold increase in the risk of dementia (Saczynski et al., 2010). Interestingly, one longitudinal study revealed that the trajectory of depression could be the most significant risk factor for the development of dementia (Kaup et al., 2016). In this study, older adults with a high and increasing depressive symptom

¹Department of Allied Health Sciences, University of Connecticut, Storrs, CT, USA

²Everest Foundation Scholar, Los Angeles, CA, USA

³Department of Medicine, Boston Medical Center, Boston, MA, USA

⁴Institute for Health, Health Care Policy and Aging Research, Rutgers University, New Brunswick, NJ, USA

⁵Department of Pulmonary Medicine, Sinai Hospital of Baltimore, Baltimore, MD, USA

⁶Department of Medicine, Bepos Hospital, Abuja, Nigeria

⁷School of Public Health Tuscaloosa, The University of Alabama System, Tuscaloosa, AL, USA

⁸Medstar Cardiovascular Research Network, Hyattsville, MD, USA

⁹School of Health and Rehabilitation Sciences, University of Pittsburgh, Pittsburgh, PA, USA

Corresponding Author:

Adeleye A. Adaralegbe, MBBS, PhD, Department of Allied Health Sciences, University of Connecticut, 358 Mansfield Road, Unit 1101 Storrs, CT 06268-1101, USA.

Email: Adeleye.Adaralegbe@uconn.edu



Creative Commons Non Commercial CC BY-NC: This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits non-commercial use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the SAGE

and Open Access pages (<https://us.sagepub.com/en-us/nam/open-access-at-sage>).

trajectory were reported to have a significantly heightened risk of dementia compared to those with consistent minimal depressive trajectory. However, in studies that try to demonstrate an association between late-life depression and dementia, the results appeared mixed. These associations have been best described as weak or unclear (Byers & Yaffe, 2011; Valiengo et al., 2016).

Aside from depression, the personality trait of an individual is another psychological risk factor that had been remotely associated with the development of dementia, albeit remotely (Terracciano et al., 2017). Some studies describe personality traits as having a direct effect on a person's behavior, lifestyle, and health (Ali, 2019; Hampson, 2012). There are five major categories of personality traits, also known as the Big-Five personality traits, described by McCrae and John (1992). These are Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness. Of these categories, both high Neuroticism and low Conscientiousness have been associated with increased risk of dementia incidence (Kaup et al., 2019; Low et al., 2013). Terracciano et al. (2017) also reported lower Conscientiousness, Agreeableness, and higher Neuroticism as independent risk factors for dementia. Furthermore, Ayers et al. (2020) highlighted that older adults with higher Openness may have a reduced risk of developing cognitive impairment.

Even though several studies have associated late-life depression and personality traits as independent risk factors for dementia, to our knowledge, no single study has evaluated how personality traits influence the way depression predicts the development of dementia in old age. Taking all these into consideration, we sought to explore if personality traits influence the association between late-life depression and the development of dementia over a period of 5 years. The purpose of this study is in two-folds; first, we sought to investigate the association between change in depression following 5 years and the risk of dementia. Second, to explore how the Big-Five personality traits influence this relationship. We utilized two waves of publicly available data, containing 2210 American older adults, from the National Social Life, Health and Aging Project (NSHAP) to explore these relationships. Although two waves of data may not establish causality, we hope to explore if there is a predilection of a particular personality trait to the development of dementia in older adults exhibiting depressive symptoms.

Methods

Study Design and Data Source

This longitudinal study utilized data from the NSHAP population-based study. The publicly available dataset was accessed from the Interuniversity Consortium for Political and Social Research (ICPSR) online website. The NSHAP study sought to explore the various health and social factors that influence the health and wellbeing of older adults across all ethnicities and gender in the United States. This study consists of three waves of data, each

collected 5 years apart, with the first and third wave collected in 2005 and 2015, respectively. Face-to-face interviews using structured questionnaires were used in the survey. The wave 1 survey had a total of 3005 participants which increased to 3400 during the Wave 2 period. A total of 4777 older adults were interviewed during the Wave 3 period. Wave 1 data was excluded from this study because the variables representing personality traits were not introduced until the Wave 2 period. Thus, we used only data from Waves 2 and 3. Additionally, only respondents who participated in both waves were included in the analysis. A cohort of 2210 older adults present in both Waves 2 (Time 1-T1) and 3 (Time 2-T2) made up our sample size for this study.

Sampling Method

The NSHAP survey selected community-residing adults based on the Health and Retirement Study's (HRS) national household screening method. A national area probability sampling method was used to determine the areas to be surveyed. A more detailed sampling method was described elsewhere (Heeringa & Conner, 1995; Waite et al., 2019).

Study Measures

Outcome Variable: We used the Montreal Cognitive Assessment (MoCA), a screening tool for cognitive impairment and early dementia, at time 2 as the outcome variable. Both Waves of NSHAP contained an 18-item MoCA screening survey questions that were extensively described by Kotwal et al. (2016). The total score for the screening scale was 30 points which was divided into three categories based on previous studies: <18 points (dementia), 18–22 points (mild cognitive impairment), and >22 points (normal). We further dichotomized this category into "Normal" coded as "0" (>22 points) and "Dementia" coded as "1" (<22 points) by merging those with mild cognitive impairment and dementia into one. We controlled for baseline Dementia (T1) because it is an important confounder as it might predict both dementia at T2 and other independent variables. Therefore, there could be reverse causality.

Independent Variables:

The two independent variables were depression and the Big-Five personality traits. Depression was measured using the 11-item Center for Epidemiological Studies Depression (CES-D) scale. Respondents were asked a set of 11 questions that were scored as 0, 1, and 2 for rarely or none of the time, some of the time, and much of the time, respectively. The scores were summed up and the participants who had a score between 0 and 22 at both time 1 and time 2 were given a CES-D score (continuous variable). Higher scores indicated a higher depression symptomology. Internal consistencies of all scales were assessed using coefficient omega (Hayes & Coutts, 2020; Peters, 2014). The coefficient omegas were 0.78 and 0.79 for CES-D at T1 and T2, respectively. We attempted to assess "Change in Depression" as a predictor of the risk for dementia rather than depression at a point in time

based on Kaup et al. (2016) findings. Therefore, the change was calculated using: (CES-D score at T2) – (CES-D score at T1).

The NSHAP survey also contained 21 items assessing personality traits. Responses to these items were recorded on a Likert scale of “0” to “3” representing “Not at all” to “A lot.” An exploratory factor analysis (EFA) was conducted on these 21 items to determine the Big-Five factor structure as conceptualized by Iveniuk et al. (2014) using varimax rotation. We had a five-factor loading for both waves of data, also reported by Iveniuk et al. (2014), except for the item “Active” that cross-loaded between Extraversion and Conscientiousness at both times. It was found that the item “Warm” also cross-loaded between Extraversion and Agreeableness at T2. The total variance explained by the five factors was 58.5 and 57.7% for times 1 and 2, respectively, and communalities greater than 0.41 for each item at both times. Our five-factor loadings represented the Big-Five traits. We maintained “Active” under Extraversion and “Warm” under Agreeableness in accordance with previous literature (Iveniuk et al., 2014; Sutin et al., 2019). Following EFA and identification of factor components, we used utilized items under each factor loading as scales for both waves. Internal consistencies for the Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism scales were 0.75, 0.69, 0.75, 0.77, and 0.68, respectively, at T1. At T2 coefficient omega were at 0.70, 0.70, 0.72, 0.75, and 0.65 in the same order, representing good reliabilities.

We adjusted for the age, gender, educational attainment, household income (relative to other American families), marital status, ethnicity, comorbidity index, and dementia at T1. Age was a continuous variable in years and ranged from 62 to 92 years at T1. The other sociodemographic variables were categorical as seen in Table 1. To control for other mortality risk factors and other medical conditions associated with dementia, we calculated the Charlson Comorbidity Index (CCI) using the modified CCI described in detail by Vasilopoulos et al. (2014).

Data Analysis

IBM SPSS statistical software v27.0 was used for all the data analytic procedures. Data were cleaned and both Waves were merged into a longitudinal format. We performed an EFA to reduce observed variables into latent variables as described above. Frequencies and percentages were used to describe categorical variables while means and SDs were used to describe continuous variables at both times. Next, chi-square test was used to compare differences between dichotomous variables (dementia) at times 1 and 2 using Fisher’s exact test. For paired continuous variables, T-test was used at both times. We used a multivariate logistic regression to examine the relationship between depression and dementia at T2, while simultaneously adjusting for sociodemographic status at T1, comorbidity index at T1, and baseline dementia. This represented our first model (Table 2). Results were expressed

in adjusted odd ratios (ORs) and corresponding p value at 0.05. Since there was no statistically significant difference between both times, we subsequently introduced each of the personality traits at T1 one at a time, into Model 1, then all at once. This was categorized as the second model. We observed the changes in regression statistics in the relationship between depression and dementia. In this second model, control variables were the same as those in the first model. All tests were two-sided and p -values less than 0.05 were considered to be statistically significant. Furthermore, the goodness-of-fit of the multivariate binary logistic regression models were assessed using the Hosmer and Lemeshow Test (Fagerland & Hosmer, 2012).

A descriptive statistic of the variables of interests was computed to assess for the distribution of missing data. Majority of the socioeconomic variables had complete data, except for income which was missing some cases. The computed outcome variable and predictor (change in CES-D score) had no missing cases, whereas the 21 variables assessing personality traits had missing cases. Percentage of missing data ranged from 1 to 31%. Patterns of missing data were non-monotone, that is, some individuals did not respond to some of the personality traits-related questions. Therefore, it was assumed that data was missing completely at random (MCAR). Five missing data imputations were created through multiple imputations using a polytomous logistic regression method. Imputation was also conducted with IBM SPSS software version 27.0.

Results

Characteristics of the Participants

The mean age of the participants in this nationally representative sample was 71.6 ± 6.6 years, consisting mainly of non-Hispanic whites (72%). The average age of people exhibiting dementia symptoms was significantly higher at both times (Table 1). There was no gender difference in the rates of dementia. However, at both times dementia was statistically significantly higher among non-married, low income earning, non-White individuals and who have attained a lower level of education (Table 1). We found no statistically significant difference in CCI rates among people with dementia, but depression was significantly higher in individuals with dementia at both times ($p < 0.001$). Among the five personality traits, people with dementia had a lower Conscientiousness mean score at both times and a lower Openness score at T2.

Model 1: Depression as a Predictor of Dementia

Table 2 shows the logistic regression analysis between change in depression and dementia at T2 while controlling for sociodemographic characteristics, CCI, and baseline dementia. Controlling for baseline dementia is equivalent to assessing the changes in dementia from T1 to T2. Change in

Table 1. Descriptive Statistics.

| Characteristics | Dementia (T1) | | p | Dementia (T2) | | p |
|--------------------------------------|-------------------|-------------------|------------------|-------------------|-------------------|------------------|
| | Yes | No | | Yes | No | |
| Age (years): Mean (\pm SD) | 73.3 (\pm 6.8) | 70.8 (\pm 6.4) | <0.001 | 78.1 (\pm 6.9) | 75.8 (\pm 6.4) | <0.001 |
| Gender: n (%) | | | | | | |
| Male | 322 (32.3) | 676 (67.7) | 0.65 | 422 (34.8) | 625 (62.6) | 0.229 |
| Female | 379 (31.3) | 833 (68.7) | | 422 (34.8) | 790 (65.2) | |
| Marital status: n (%) | | | | | | |
| Married | 451 (28.8) | 1114 (71.2) | <0.001 | 469 (33.4) | 935 (66.6) | 0.006 |
| Living with a partner | 17 (37.0) | 29 (63.0) | | 17 (45.9) | 20 (54.1) | |
| Separated | 9 (45.0) | 11 (55.0) | | 12 (46.2) | 14 (53.8) | |
| Divorced | 60 (34.7) | 113 (65.3) | | 65 (34.4) | 124 (65.6) | |
| Widowed | 150 (41.2) | 214 (58.8) | | 219 (42.4) | 297 (57.6) | |
| Never married | 14 (33.3) | 28 (66.7) | | 13 (34.2) | 25 (65.8) | |
| Education: n (%) | | | | | | |
| < high school | 257 (66.8) | 128 (33.2) | <0.001 | 231 (60.0) | 154 (40.0) | <0.001 |
| High school/equivalence | 190 (35.1) | 352 (64.9) | | 223 (41.1) | 319 (58.9) | |
| Some college | 182 (26.4) | 507 (73.6) | | 229 (33.2) | 460 (66.8) | |
| Bachelors or greater | 72 (12.1) | 522 (87.9) | | 112 (18.9) | 482 (81.1) | |
| Ethnicity: n (%) | | | | | | |
| White | 365 (22.7) | 1241 (77.3) | <0.001 | 485 (30.2) | 1121 (69.8) | <0.001 |
| Black | 172 (55.0) | 141 (45.0) | | 179 (57.2) | 134 (42.8) | |
| Hispanic | 148 (63.2) | 86 (36.8) | | 115 (49.1) | 119 (50.9) | |
| Other | 14 (28.6) | 35 (71.4) | | 14 (28.6) | 35 (71.4) | |
| Income RTAF: n (%) | | | | | | |
| Far below average | 66 (42.9) | 88 (57.1) | <0.001 | 57 (50.4) | 56 (49.6) | <0.001 |
| Below average | 171 (36.5) | 298 (63.5) | | 135 (36.9) | 231 (63.1) | |
| Average | 268 (31.9) | 571 (68.1) | | 306 (36.2) | 539 (63.8) | |
| Above average | 51 (13.8) | 319 (86.2) | | 106 (24.1) | 334 (75.9) | |
| Far above average | 3 (5.4) | 53 (94.6) | | 14 (19.7) | 57 (80.3) | |
| Comorbidity index: Mean (\pm SD) | 2.0 (\pm 1.6) | 1.7 (\pm 1.6) | 0.331 | 1.7 (\pm 1.6) | 1.5 (\pm 1.5) | 0.072 |
| CES-D score: Mean (\pm SD) | 5.1 (\pm 4.6) | 3.9 (\pm 3.8) | <0.001 | 5.9 (\pm 4.7) | 4.3 (\pm 4.0) | <0.001 |
| Personality Scales: Mean (\pm SD) | | | | | | |
| Openness | 1.8 (\pm 0.7) | 1.9 (\pm 0.6) | 0.179 | 1.8 (\pm 0.6) | 1.9 (\pm 0.6) | 0.042 |
| Conscientiousness | 2.3 (\pm 0.5) | 2.4 (\pm 0.5) | 0.005 | 2.3 (\pm 0.6) | 2.4 (\pm 0.5) | <0.001 |
| Extraversion | 2.2 (\pm 0.6) | 2.2 (\pm 0.5) | 0.486 | 2.2 (\pm 0.5) | 2.2 (\pm 0.5) | 0.830 |
| Agreeableness | 2.4 (\pm 0.5) | 2.5 (\pm 0.5) | 0.980 | 2.4 (\pm 0.5) | 2.5 (\pm 0.5) | 0.166 |
| Neuroticism | 1.3 (\pm 0.6) | 1.2 (\pm 0.6) | 0.814 | 1.3 (\pm 0.6) | 1.2 (\pm 0.6) | 0.212 |

RTAF = Relative to American families. T = T-test, C = Chi-square for bivariate analysis.

depression increased the likelihood of dementia at T2 by 4.2% (AOR = 1.042, $p = 0.019$). Although used as control variables, age (AOR = 1.077, $p = 0.000$) and ethnicity (AOR = 1.355, $p = 0.001$) positively contributed to dementia at T2, whereas educational attainment decreased the odds of dementia (AOR = 0.658, $p = 0.000$).

Model 2: The Influence of Personality Traits

In model 2 (Table 3), each of the Big-Five personality traits were initially introduced into the first model one at a time, followed by the addition of the five traits simultaneously. Since the personality trait did not significantly change after 5 years (Table 1),

we used personality traits at T1 in model 2. In this model, change in depression was the predictor variable, dementia at T2 was the outcome while other control variables remained the same. For Openness to experience, the relationship between depression and dementia remained the same, similar to model 1 (AOR = 1.043, $p = 0.022$). That is, being predominantly open to experience did not influence the relationship between depression and dementia in old age. Similarly, Conscientiousness did not influence the relationship as it only increased the odds of dementia from depression by 4.5% (from 4.2%).

Being extraverted improved the model significantly, that is, Hosmer and Lemeshow χ^2 improved from 5.51 to 17.29, and extraversion itself was the only personality trait that

Table 2. Model 1: Relationship between depression and dementia at T2.

| Predictor | B | SE | Wald | <i>p</i> | OR |
|--------------------|-------|------|--------|--------------|------|
| Depression | 0.04 | 0.02 | 5.51 | 0.019 | 1.04 |
| Age | 0.07 | 0.01 | 46.56 | 0.000 | 1.08 |
| Sex | 0.27 | 0.14 | 3.74 | 0.053 | 1.32 |
| Education | −0.42 | 0.08 | 28.74 | 0.000 | 0.66 |
| Ethnicity | 0.30 | 0.09 | 10.48 | 0.001 | 1.36 |
| Marital status | −0.28 | 0.17 | 2.87 | 0.090 | 0.75 |
| Income RTAF | −0.13 | 0.09 | 2.23 | 0.136 | 0.88 |
| Comorbidity index | 0.03 | 0.04 | 0.66 | 0.418 | 1.03 |
| Dementia at time 1 | 1.61 | 0.15 | 109.56 | 0.000 | 4.99 |

The goodness-of-fit was evaluated by Hosmer and Lemeshow $\chi^2 = 5.51$, $p = 0.702$.

Table 3. Model 2: Influence of Personality Traits on the Relationship Between Depression and Dementia.

| Personality Trait | New Regression statistics for Depression with control variables | | | |
|---------------------------|---|--------------|------|-----------------------|
| | B | <i>p</i> | OR | χ^2 (<i>p</i>) |
| Openness | 0.04 | 0.022 | 1.04 | 6.74 (0.565) |
| Conscientiousness | 0.04 | 0.017 | 1.05 | 5.79 (0.671) |
| Extraversion ^a | 0.05 | 0.009 | 1.05 | 17.29 (0.027) |
| Agreeableness | 0.03 | 0.067 | 1.04 | 3.61 (0.891) |
| Neuroticism | 0.04 | 0.040 | 1.04 | 8.63 (0.374) |
| All | 0.05 | 0.018 | 1.05 | 6.55 (0.586) |

The goodness-of-fit was evaluated by Hosmer and Lemeshow χ^2 .

^aStatistically significant relationship with dementia itself.

statistically significantly predicted dementia among the other traits. Additionally, Extraversion also slightly increased the odds of depression leading to dementia in old age to 4.8%. With Agreeableness, depression did not predict dementia. Conversely, Neuroticism, although it improved the model (Hosmer and Lemeshow $\chi^2=8.63$), it did not influence how depression predicts dementia. Surprisingly, however, it slightly decreased the odds of developing dementia from depression (from 4.2 to 3.9%). Finally, the addition of all the Big-Five traits into the model improved it only slightly, with the odds at 1.049.

Discussion

Consistent with other studies, our analysis of data from this population-based longitudinal study showed the well-documented association between depression and the development of dementia among older adults (Bellou et al., 2017; Ly et al., 2021; Saczynski et al., 2010; Valkanova et al., 2017). We see this association after adjusting for sociodemographic characteristics, strengthening the legitimacy of this finding. Bryers and Yaffe and Valiengo et al. (2016) reported weak or unclear associations between late-life

depression and dementia. The significant association seen in our study suggests otherwise. However, the existence of depressive symptoms prior to T1 was not ascertained. Neuropsychiatry symptoms like depression are sometimes a component of the symptomatic spectrum of dementia (Cerejeira et al., 2012; Yatawara et al., 2018). Though there was a significant increase in depression scores over the study period, there remains a chance that association seen in our study is due to depression as a symptom of dementia in these patients.

Of the sociodemographic characteristics controlled for, increasing age and ethnicity significantly predicted the development of dementia while higher educational attainment was protective. Age and ethnicity have been known to influence the development of dementia (Masel et al., 2010; Momtaz et al., 2013). Two possible mechanisms for the protective effect of education in the development of dementia were suggested by Orrell and Sahakian (1995). First, education improves neuronal networking such that there is a larger pool of neurons that can perform the same functional tasks, delaying the onset of dementia with neuronal aging. Second, higher socioeconomic status and education is more likely to result in a greater neural reserve and premorbid intellect thus slowing the cognitive decline. This reinforces the need to promote early life educational pursuits in the general population which can positively influence cognitive functioning in late life (Lövdén et al., 2020; Momtaz et al., 2013). Though not statistically significant in our study, having a partner positively affected the association between depression and dementia, reducing the likelihood of the latter. Prior studies have shown similar results, which emphasizes the protective effects of healthy long-term relationships and social support in depressed patients (Sjöberg et al., 2020; Sundström et al., 2016).

To explore how the Big-Five personality traits influence the relationship between depression and dementia, we adjusted for the five traits. After including all five traits in the sociodemographic-adjusted model, the significant relationship between depression and dementia remained the same, suggesting no confounding effect of personality traits on this relationship in our study population. However, individually, neuroticism slightly decreased the odds of dementia in depressed patients, while openness, conscientiousness, and extroversion resulted in slightly increased or unchanged odds. These findings were interesting because previous studies have reported higher incidence of dementia in patients with lower conscientiousness and higher neuroticism (Low et al., 2013; Terracciano et al., 2017), and a possible reduced risk of cognitive impairment in patients with higher openness (Ayers et al., 2020).

We expected neuroticism to be strongly associated with higher depression and increase the likelihood of dementia. However, our findings suggest otherwise. Since previous studies did not account for depression, the observed difference may be due to this. A meta-analysis by Kotov et al.

(2010) showed that patients with depression scored higher than non-clinically depressed samples on neuroticism, and lower on extraversion and conscientiousness. This association was also seen in a cross-sectional study involving patients with a diagnosis of major depressive episodes (Jourdy & Petot, 2017).

Other findings of interest were observed for agreeableness and extraversion. Agreeableness nullified the effect of depression on the development of dementia in our older adult study population while extraversion was observed to significantly increase the model fit despite no significant difference in the odds (compared to Model 1). Moreover, extraversion was the only personality trait that was significantly related to change in depression. Most studies that explored the relationship between agreeableness and dementia reported a negative association (Aschwanden et al., 2021; Terracciano et al., 2014, 2017). Notably, agreeableness was strongly associated with a better performance of four out of the five cognitive domains in another study (Sutin et al., 2019). These study reports of the positive influence of agreeableness on cognition support our findings on this personality trait nullifying the effect of depression on dementia. However, a longitudinal study identified agreeableness, together with neuroticism, as a major personality trait that can alter parahippocampal cortices of the brain (Block, 1993). The prosocial nature of agreeableness likely has a positive effect, significant enough to slow the development of dementia in older adults with depressive symptoms. On the other hand, being extraverted in old age may significantly increase not only the risk of dementia, but also the strength of depression predilection to dementia.

From the foregoing, our expectation was to find a confounding effect of personality traits given its independent association with both depression and dementia. Our study results instead, suggest that the association between depression and dementia remains the same irrespective of personality traits. This may be because personality traits of our study participants did not change significantly over the 5-year study period. Some previous longitudinal studies also highlighted no personality change in old age (Allemand et al., 2008; McCrae & Costa, 2003), supporting our findings in this large, longitudinal, and population-based sample of older Americans.

One particular strength of this study is that aside from being a population-based sample, the demography (particularly ethnicity) of the sample of older adults' mirrors that of the US Census report (Roberts et al., 2018). This consolidates the generalizability of our findings. Additionally, it may appear to be the first study to our knowledge to investigate the relationship between these psychosocial factors. Despite the contribution of this study to the understanding of how personality traits influence the association of late-life depression with dementia, this study has limitations. First, the use of secondary data constrained our variables of interest such that we were unable to utilize the first wave of the survey. Second, longitudinal studies require more than two data points for best

practices. However, this study utilized two waves of data with two time points. For this reason, we could not claim any causality in the reported associations.

Conclusion

From this study, we conclude that personality traits, overall, do not influence how depression predicts the development of dementia in old age. However, agreeableness and extraversion personality traits may have some impact on this relationship. Prosocial behaviors should be promoted in old age as these appear to be protective. In addition, early life education and a strong social support can keep the depression–dementia spectrum at bay in old age. Future research may explore how personality traits influenced the relationship between chronic depression and the development of dementia in old age.


Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

ORCID iDs

Adeleye A. Adaralegbe, MBBS, PhD  <https://orcid.org/0000-0002-9230-3329>

Henry Egbuchiem, MD  <https://orcid.org/0000-0002-2623-9218>
Oluwatomi Adeoti, MD, MPH  <https://orcid.org/0000-0003-1483-6274>

Khuzeman Abbasi, MD  <https://orcid.org/0000-0002-4130-1569>

References

- Ali, I. (2019). Personality traits, individual innovativeness and satisfaction with life. *Journal of Innovation & Knowledge*, 4(1), 38–46. <https://doi.org/10.1016/j.jik.2017.11.002>
- Allemand, M., Zimprich, D., & Martin, M. (2008). Long-term correlated change in personality traits in old age. *Psychology and Aging*, 23(3), 545–557. <https://doi.org/10.1037/a0013239>
- Aschwanden, D., Strickhouser, J. E., Luchetti, M., Stephan, Y., Sutin, A. R., & Terracciano, A. (2021). Is personality associated with dementia risk? A meta-analytic investigation. *Ageing Research Reviews*, 67(5), 101269. <https://doi.org/10.1016/j.arr.2021.101269>
- Ayers, E., Gully, E., & Verghese, J. (2020). The effect of personality traits on risk of incident pre-dementia syndromes. *Journal of the American Geriatrics Society*, 68(7), 1554–1559. <https://doi.org/10.1111/jgs.16424>
- Bellou, V., Belbasis, L., Tzoulaki, I., Middleton, L. T., Ioannidis, J., & Evangelou, E. (2017). Systematic evaluation of the associations between environmental risk factors and dementia: an umbrella review of systematic reviews and meta-analyses. *Alzheimer's &*

- Dementia: The Journal of the Alzheimer's Association*, 13(4), 406–418. <https://doi.org/10.1016/j.jalz.2016.07.152>
- Block, J. (1993). Studying personality the long way. In D. C. Funder, R. D. Parke, C. Tomlinson-Keasey, & K. Widaman (Eds.), *Studying lives through time: Personality and development* (pp. 9–41). American Psychological Association. <https://doi.org/10.1037/10127-018>
- Byers, A. L., & Yaffe, K. (2011). Depression and risk of developing dementia. *Nature Reviews Neurology*, 7(6), 323–331. <https://doi.org/10.1038/nrneurol.2011.60>
- Campbell, N. L., Unverzagt, F., LaMantia, M. A., Khan, B. A., & Boustani, M. A. (2013). Risk factors for the progression of mild cognitive impairment to dementia. *Clinics in Geriatric Medicine*, 29(4), 873–893. <https://doi.org/10.1016/j.cger.2013.07.009>
- Cerejeira, J., Lagarto, L., & Mukaetova-Ladinska, E. B. (2012). Behavioral and psychological symptoms of dementia. *Frontiers in neurology*, 3(■), 73. <https://doi.org/10.3389/fneur.2012.00073>
- Fagerland, M. W., & Hosmer, D. W. (2012). A generalized hosmer–lemeshow goodness-of-fit test for multinomial logistic regression models. *The Stata Journal*, 12(3), 447–453. <https://doi.org/10.1177/1536867X1201200307>
- Hampson, S. E. (2012). Personality processes: Mechanisms by which personality traits get outside the skin. *Annual Review of Psychology*, 63(1), 315–339. <https://doi.org/10.1146/annurev-psych-120710-100419>
- Hayes, A. F., & Coutts, J. J. (2020). Use omega rather than Cronbach's alpha for estimating reliability. *But. Communication Methods and Measures*, 14(1), 1–24. <https://doi.org/10.1080/19312458.2020.1718629>
- Heeringa, S. G., & Conner, J. (1995). *Technical description of health and retirement study sample design (HRS/AHEAD Documentation Report DR-002)*. University of Michigan, Institute for Social Research.
- Iveniuk, J., Laumann, E. O., Waite, L. J., McClintock, M. K., & Tiedt, A. (2014). Personality measures in the national social life, health, and aging project. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, 69(Suppl 2), S117–S124. <https://doi.org/10.1093/geronb/gbu073>
- Jourdy, R., & Petot, J.-M. (2017). Relationships between personality traits and depression in the light of the “Big Five” and their different facets. *L'Évolution Psychiatrique*, 82(4), e27–e37. <https://doi.org/10.1016/j.evopsy.2017.08.002>
- Kaup, A. R., Byers, A. L., Falvey, C., Simonsick, E. M., Satterfield, S., Ayonayon, H. N., Smagula, S. F., Rubin, S. M., & Yaffe, K. (2016). Trajectories of depressive symptoms in older adults and risk of dementia. *JAMA Psychiatry*, 73(5), 525–531. <https://doi.org/10.1001/jamapsychiatry.2016.0004>
- Kaup, A. R., Harmell, A. L., & Yaffe, K. (2019). Conscientiousness is associated with lower risk of dementia among black and white older adults. *Neuroepidemiology*, 52(1–2), 86–92. <https://doi.org/10.1159/000492821>
- Kotov, R., Gamez, W., Schmidt, F., & Watson, D. (2010). Linking “big” personality traits to anxiety, depressive, and substance use disorders: A meta-analysis. *Psychological Bulletin*, 136(5), 768–821. <https://doi.org/10.1037/a0020327>
- Kotwal, A. A., Kim, J., Waite, L., & Dale, W. (2016). Social function and cognitive status: Results from a US nationally representative survey of older adults. *Journal of General Internal Medicine*, 31(8), 854–862. <https://doi.org/10.1007/s11606-016-3696-0>
- Lopez, O. L., & Kuller, L. H. (2019). Epidemiology of aging and associated cognitive disorders: Prevalence and incidence of Alzheimer's disease and other dementias. *Handbook of Clinical Neurology*, 167, 139–148. <https://doi.org/10.1016/B978-0-12-804766-8.00009-1>
- Lövdén, M., Fratiglioni, L., Glymour, M. M., Lindenberg, U., & Tucker-Drob, E. M. (2020). Education and cognitive functioning across the life span. *Psychological Science in the Public Interest: A Journal of the American Psychological Society*, 21(1), 6–41. <https://doi.org/10.1177/1529100620920576>
- Low, L. F., Harrison, F., & Lackersteen, S. M. (2013). Does personality affect risk for dementia? A systematic review and meta-analysis. *The American Journal of Geriatric Psychiatry*, 21(8), 713–728. <https://doi.org/10.1016/j.jagp.2012.08.004>
- Ly, M., Karim, H. T., Becker, J. T., Lopez, O. L., Anderson, S. J., Aizenstein, H. J., Reynolds, C. F., Zmuda, M. D., & Butters, M. A. (2021). Late-life depression and increased risk of dementia: A longitudinal cohort study. *Translational Psychiatry*, 11(1), 147. <https://doi.org/10.1038/s41398-021-01269-y>
- Masel, M. C., Raji, M., & Peek, M. K. (2010). Education and physical activity mediate the relationship between ethnicity and cognitive function in late middle-aged adults. *Ethnicity & Health*, 15(3), 283–302. <https://doi.org/10.1080/13557851003681273>
- McCrae, R. R., & Costa, P. T., Jr. (2003). *Personality in adulthood: A five-factor theory perspective* (2nd ed.). Guilford Press. <https://doi.org/10.4324/9780203428412>
- McCrae, R. R., & John, O. P. (1992). An introduction to the five-factor model and its applications. *Journal of Personality*, 60(2), 175–215. <https://doi.org/10.1111/j.1467-6494.1992.tb00970.x>
- Momtaz, Y. A., Hamid, T. A., Yusoff, S., & Ibrahim, R. (2013). Do depression and educational attainment mediate the association between ethnicity and dementia? *Gerontology*, 59(3), 206–212. <https://doi.org/10.1159/000342254>
- Orrell, M., & Sahakian, B. (1995). Education and Dementia. *BMJ*, 310(6985), 951–952. <https://doi.org/10.1136/bmj.310.6985.951>
- Peters, G. J. (2014). The alpha and the omega of scale reliability and validity: Why and how to abandon Cronbach's alpha and the route towards more comprehensive assessment of scale quality. *Euro Health Psychologist*, 16(2), 56–69. <https://doi.org/10.31234/osf.io/h47fv>
- Roberts, A. W., Ogunwole, S. U., Blakeslee, L., & Rabe, M. A. (2018). *The population 65 years and older in the United States: 2016*. US Department of Commerce, Economics and Statistics Administration, US Census Bureau.
- Saczynski, J. S., Beiser, A., Seshadri, S., Auerbach, S., Wolf, P. A., & Au, R. (2010). Depressive symptoms and risk of dementia: The Framingham Heart Study. *Neurology*, 75(1), 35–41. <https://doi.org/10.1212/WNL.0b013e3181e62138>
- Sjöberg, L., Fratiglioni, L., Lövdén, M., & Wang, H. X. (2020). Low mood and risk of dementia: The role of marital status and living

- situation. *The American Journal of Geriatric Psychiatry: Official Journal of the American Association for Geriatric Psychiatry*, 28(1), 33–44. <https://doi.org/10.1016/j.jagp.2019.08.014>
- Sundström, A., Westerlund, O., & Kotyrló, E. (2016). Marital status and risk of dementia: A nationwide population-based prospective study from Sweden. *BMJ open*, 6(1), e008565. <https://doi.org/10.1136/bmjopen-2015-008565>
- Sutin, A. R., Stephan, Y., Luchetti, M., & Terracciano, A. (2019). Five-factor model personality traits and cognitive function in five domains in older adulthood. *BMC Geriatrics*, 19(1), 1–10. <https://doi.org/10.1186/s12877-019-1362-1>
- Terracciano, A., Stephan, Y., Luchetti, M., Albanese, E., & Sutin, A. R. (2017). Personality traits and risk of cognitive impairment and dementia. *Journal of Psychiatric Research*, 89(■), 22–27. <https://doi.org/10.1016/j.jpsychires.2017.01.011>
- Terracciano, A., Sutin, A. R., An, Y., O'Brien, R. J., Ferrucci, L., Zonderman, A. B., & Resnick, S. M. (2014). Personality and risk of Alzheimer's disease: new data and meta-analysis. *Alzheimer's & Dementia: The Journal of the Alzheimer's Association*, 10(2), 179–186. <https://doi.org/10.1016/j.jalz.2013.03.002>
- Valiengo, L., Stella, F., & Forlenza, O. V. (2016). Mood disorders in the elderly: Prevalence, functional impact, and management challenges. *Neuropsychiatric disease and treatment*, 12(■), 2105–2114. <https://doi.org/10.2147/NDT.S94643>
- Valkanova, V., Ebmeier, K. P., & Allan, C. L. (2017). Depression is linked to dementia in older adults. *The Practitioner*, 261(1800), 11–15.
- Vasilopoulos, T., Kotwal, A., Huisingh-Scheetz, M. J., Waite, L. J., McClintock, M. K., & Dale, W. (2014). Comorbidity and chronic conditions in the national social life, health and aging project (NSHAP), wave 2. *The journals of gerontology. Series B, Psychological Sciences and Social Sciences*, 69(Suppl 2), S154–S165. <https://doi.org/10.1093/geronb/gbu025>
- Waite, L., Cagney, K., Dale, W., Hawkey, L., Huang, E., Lauderdale, D., & Schumm, L. (2019). *National social life, health and aging project (NSHAP): Wave 3, [United States], 2015–2016*. Inter-university Consortium for Political and Social Research.
- Yatawara, C., Hiu, S., Tan, L., & Kandiah, N. (2018). Neuropsychiatric symptoms in South-East Asian patients with mild cognitive impairment and dementia: Prevalence, subtypes, and risk factors. *International Journal of Geriatric Psychiatry*, 33(1), 122–130. <https://doi.org/10.1002/gps.4693>
- Yu, O. C., Jung, B., Go, H., Park, M., & Ha, I. H. (2020). Association between dementia and depression: A retrospective study using the Korean national health insurance service-national sample cohort database. *BMJ Open*, 10(10), e034924. <https://doi.org/10.1136/bmjopen-2019-034924>