



Prodromal or mild Alzheimer's disease: Influence of neuropsychiatric symptoms and premorbid personality on caregivers' burden

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Abstract

Objective: In Alzheimer's disease (AD), the burden on caregivers is influenced by various factors, including the stage of disease progression and neuropsychiatric symptoms (NPS). To date, there has been limited research examining how patient's premorbid personality could affect this burden. The objective of this study was to investigate the impact of both premorbid personality and NPS in individuals with prodromal to mild AD on their caregivers' burden.

Method: One hundred eighty participants with prodromal or mild AD drawn from the PACO (in French: Personnalité Alzheimer COmportement) cohort were included. Personality was assessed by the Revised NEO Personality Inventory (NEO-PI-R). Neuropsychiatric symptoms were measured with the short version of the Neuropsychiatric Inventory (NPI-Q), and caregiver burden was evaluated with the Zarit burden scale. Relationships between personality, Neuro-Psychiatric Inventory (NPI) scores, and caregiver burden were determined using multivariate linear regressions controlled for age, sex, educational level, and Mini Mental State Examination.

Results: The total NPI score was related to increased burden ($\beta = 0.45$; $p < 0.001$). High level of neuroticism ($\beta = 0.254$; $p = 0.003$) et low level of conscientiousness ($\beta = -0.233$; $p = 0.005$) were associated higher burden. Extraversion ($\beta = -0.185$; $p = 0.027$) and conscientiousness ($\beta = -0.35$; $p = 0.006$) were negatively associated with burden. In contrast, neuroticism, openness and agreeableness were not correlated with burden. When adjusted on total NPI score, the relationship between extraversion and conscientiousness didn't persist.

Conclusion: Our results suggest that premorbid personality of patients with prodromal to mild Alzheimer influence caregivers's burden, with a protective effect of a high level of extraversion and conscientiousness.

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KEYWORDS

Alzheimer, burden, caregiver, symptoms personality

Key points

The premorbid personality of AD patients could have a direct and indirect impact on caregiver burden

Personality assessment could

- help identify patients at increased risk of neuropsychiatric symptoms
- enable the implementation of preventive support measures for patients and their caregivers.

1 | INTRODUCTION

Alzheimer's disease (AD) is a progressive neurodegenerative disorder characterized by a cognitive decline affecting episodic memory in a predominant way and leading to a loss of independence and behavioral changes.

The occurrence of AD affect the organization and balance of the family, and have a major impact on the quality of life and well-being of caregivers.¹ Caregiver's burden refers to the objective and subjective difficulties that this latter may experience in caring for the patient.² It is a multidimensional concept including emotional and medical domains as well as economic and social ones. High burden increases the risk of psychological and physical exhaustion, and is known to be strongly correlated with caregiver poor mental health, and to increase the risk of developing or exacerbating somatic diseases^{3,4}. Moreover, it contribute to alter the quality of the relationship with the patient, resulting in certain situations in dysfunctional attitudes worsening existing difficulties.⁵ In practice, it is therefore crucial to identify caregivers in vulnerable situations in order to implement preventive or supportive measures.

The burden relies on multiple factors specific to the patient, the disease, the caregiver and the environment. Severity of cognitive decline, rate of progression of the disease, loss of autonomy and behavioral disorders are strongly correlated with the level of distress of the relatives.^{6,7} The psychological profile of caregivers, their sensitivity to stress (high level of neuroticism) and their coping skills influence their subjective experience and may contribute to major their burden.^{8,9} The level of isolation, accessibility of professional support, the quality of the social network and family communication, and economic conditions are also to be considered.¹⁰⁻¹² It has been demonstrated that the onset of AD is accompanied by changes in personality, including an increase in the level of neuroticism, and a decrease in the levels of extraversion and conscientiousness.¹³⁻¹⁵ If personality changes occurring during the course of the disease can adversely impact caregiver's experience, little is known about the influence of the patient's premorbid personality.^{13,16} Personality characteristics shape coping skills and the quality of the relationship with others. Therefore, based on the organization of their premorbid personality, patients may exhibit varying levels of capability in adjusting to their illness,

maintaining a positive outlook, or accepting their diminished independence and the support needed. As a result, this can influence the extent of burden encountered by their family caregivers.

In this perspective, the main objective of this study was to evaluate the impact of the premorbid personality of patients with prodromal to mild AD on caregivers' burden. Knowing that personality influence the behavioral expression of AD and that neuropsychiatric symptoms (NPS) favor caregiver burden the secondary objectives were to assess the modulating role of NPS on the relationship between personality and burden.^{17,18}

2 | METHODS

2.1 | Study design

This research was based on data from the Personality Alzheimer's Behavior (PACO) study (in French: Personnalité Alzheimer Comportement). The PACO study is a prospective study whose objective was to measure the effect of personality on the emergence of NPS in AD. The methodology has been published in a previous paper.¹⁹ Participants were recruited in France from 10 memory consultations. At baseline, a comprehensive neuropsychological assessment and a personality assessment were performed. The duration of the study was 18 months with a 6-monthly reassessment of several parameters, including NPS and caregiver burden. All the scales used in this research were translated and validated in French.

The analysis of this present study focuses on the cross-sectional data collected at the third 18-month follow-up. From the initial baseline recruitment of 237 participants, 180 remained present and constitute the studied sample.

2.2 | Inclusion criteria

The inclusion criteria for the PACO study were as follows:

- AD diagnosis based on neuropsychological evaluation and Magnetic Resonance Imaging biomarkers according to Dubois et al.

criteria.²⁰ The distinction between AD stages relied on Clinical Dementia Rating score measured as 0.5 for prodromal stage and 1 for mild stage²¹:

- Mini Mental State Examination (MMSE) score >19/30²²;
- Age >50 years;
- Presence of a caregiver close enough to describe the behavioral changes;
- No significant behavioral problems at inclusion except from mild depression, anxiety, or apathy on the Neuro-Psychiatric Inventory (NPI) scale²³;

2.3 | Patient consent and ethical considerations

Written consent was obtained from participants and their caregivers prior to inclusion in the protocol. The PACO study was approved by the Lyon Southeast Personal Protection Committee and registered in the Clinical Trials Database (Current Controlled Trials NCT01297140, <http://clinicaltrials.gov/show/NCT01297140>).

2.4 | Variables collected

2.4.1 | Assessment of personality at baseline

At baseline, participants were asked to describe their premorbid personality as it was up to 5 years prior to cognitive impairment.

Personality was measured with Revised NEO Personality Inventory (NEO-PI-R).²⁴ This scale is derived from the Big Five model, which proposes to summarize personality across five dimensions: neuroticism, extraversion, openness, conscientiousness and agreeableness. This personality questionnaire is composed of 240 items rated on a 5-points Likert scale with a score between 0 and 4. The participant is asked to give his level of approval for each of the statements making up the items (e.g., I am the kind of person who worries easily; level of approval: completely agree, somewhat agree, neutral, somewhat disagree, completely disagree). The total score for each of the personality dimensions is based on 48 items, and ranges from 0 to 192.

2.4.2 | Assessment of neuropsychiatric symptoms at 18-month follow-up

Neuropsychiatric symptoms were assessed with the reduced version of the NPI (NPI-Q).²⁵ The NPI scale is one of the main tools for measuring NPS in neurodegenerative diseases. It is a caregiver-completed hetero-questionnaire that captures the presence and severity of 12 different types of NPS: delusions, hallucinations, agitation, anxiety, euphoria, apathy, behavioral impulsivity, mood lability, aberrant motor behaviors, eating disorders, and sleep disorders. The intensity score for each symptom ranged from 0 to 3 (absent, mild, moderate, severe); the addition of each of these scores

allows calculation of a global behavioral burden ranging from 0 to 36 (Total NPI Score).

2.4.3 | Assessment of caregiver burden at 18-month follow-up

The participants in this study consisted solely of family caregivers, with no involvement of paid caregivers. The assessment of caregiver burden, which includes both psychological and physical challenges, was carried out using the Mini-Zarit scale.^{26,27} This is a scale used routinely in clinical practice. It assesses the burden on the based on seven items exploring the impact of the assistance on the physical, mental and social situation of the caregiver by also including dimensions such as the feeling of effectiveness, fear of the future, or the ability to ask for help. A score between 0 and 1 is assigned to each item according to the level of difficulty perceived (e.g.: do you feel a burden when caring for your relative? Never: 0 point; sometimes: 0.5 point, often: 1 point). The global burden score, obtained by adding the score of each item, ranges between 0 and 7.

2.4.4 | Collection of co-variables at 18 months

Age, gender, educational level, and MMSE were collected as co-variables for data adjustment of statistical analyses.

3 | STATISTICAL ANALYSES

3.1 | Descriptive analyses

A descriptive analysis was performed on all study variables, including personality dimension scores at baseline, NPI and Mini-Zarit score at 18-month visit, using tendency and dispersion measures for quantitative variables and relative and absolute frequencies for qualitative variables. Quantitative variables were presented as means with their standard deviation, and qualitative variables were presented as percentage frequency.

3.2 | Associations between personality, NPI scores, caregiver burden

Relationships between personality, NPI scores, and caregiver burden were determined using multivariate linear regressions controlled for age, sex, educational level, and MMSE with beta weight denoting standardized slope estimates.

Assuming that NPS are related to both caregiver burden and personality, the relationship between personality and burden was then analyzed by controlling on the NPI.

A p value < 0.05 was considered statistically significant.

Analyses were performed with SPSS software version 21 (SPSS Software).

4 | RESULTS

4.1 | Description of the sample

At baseline, 237 participants with early-stage AD were included, of whom 65% ($n = 155$) were at CDR stage 0.5 and 35% ($n = 82$) were at CDR stage 1. One hundred and eighty patients were still present in the study at 18-month follow-up. Table 1, which summarizes the characteristics of the sample, also mentions the scores in each of the personality dimensions. The mean MMSE score was 22/30 ($+/- 4.09$), which corresponds to the early stage of AD.

Table 2 displays the frequency of NPS at 18 months. Apathy, irritability and anxiety were the three most frequent symptoms.

4.2 | Relationships between personality, neuropsychiatric symptoms and caregiver burden

Linear regression models adjusted for age, gender, educational level, and MMSE were performed to measure the relationship between personality dimension, NPS, and caregiver burden. Table 3 presents

the relationship between personality and NPS. A higher level of neuroticism was associated with a higher behavioral load, whereas a higher level of conscientiousness appeared to be related to a weaker behavioral load.

Table 4 shows the relationship between behavioral symptoms and caregiver burden. The total NPI score was highly related to increased burden. Detailed analysis of behavioral symptoms of behavioral symptoms indicates that hallucinations, agitation, depression, anxiety, apathy, irritability, and aberrant motor behaviors are most specifically related to burden. Apathy was the behavioral manifestation most strongly related to burden.

4.3 | Relationships between neuropsychiatric symptoms and caregiver burden

The relationship between patient personality profile and caregiver burden is presented in Table 5. Extraversion and conscientiousness were negatively associated with burden. In contrast, there was no relationship between the level of neuroticism, openness and agreeableness and burden. When adjusting for the total NPI score, the relationship between extraversion and conscientiousness did not persist, but the relationship between total NPI score and burden remained significant ($p < 0.001$).

5 | DISCUSSION

The objective of this study was to assess the impact of NPS and personality on caregiver burden of patients with early AD. Our results show a positive correlation between NPS intensity and burden, as well as a protective effect of high levels of extraversion and conscientiousness on caregiver distress, which had never been demonstrated before.

TABLE 2 Frequency of neuropsychiatric symptoms in the study sample.

	N	%
Delusional ideas	8	5.1
Hallucinations	6	3.4
Agitation	32	18.2
Depression	47	27.1
Anxiety	68	39.3
Euphoria	17	9.7
Apathy	85	48.9
Disinhibition	12	7.9
Irritability	75	43.3
Aberrant motor behaviors	14	9
Sleep disorders	23	13.1
Appetite disorders	26	16

TABLE 1 Characteristics of the population.

	N	%
Gender		
Male	78	43.3
Woman	102	56.7
Level of education		
<5 years	10	5.7
5–8 years old	58	33.1
9–11 years old	71	40.6
>11 years old	36	20.6
	Mean	SD
Age in years	79.22	6.4
MMSE	22.5	4.09
Mini-zarit	2	1.7
Total NPI	3.78	3.5
NEO-PI-R score		
Neuroticism (0–192)	80.37	19.07
Extraversion (0–192)	95.28	14.87
Opening (0–192)	89.86	15.07
Agreeableness (0–192)	134.93	15.41
Conscientiousness (0–192)	115.63	15.85

5.1 | Frequency of neuropsychiatric symptoms

Our study involved a sample of patients with prodromal or mild AD with an average MMSE of around 22/30. We found a high prevalence of behavioral disorders, especially apathy, present in almost half of the patients, but also irritability (42%), anxiety (37%) and depression (27%). Other publications have found higher prevalence, in particular of apathy, which may concern up to 90% of people with AD.^{8,28,29} This lower frequency of NPS in our study may be explained by our inclusion criteria, limited to prodromal or mild stage of the disease.

5.2 | Relationship between neuropsychiatric symptoms and caregiver burden

We found a highly significant association between global behavioral load (reflected by the NPI total score) and caregiver burden. The association between global behavioral load and burden has been

investigated previously, and our results were expected.^{8,9} Regardless of the neurodegenerative process (AD or other), behavioral disorders are known to strongly influence burden,^{30,31} even more than cognitive decline or loss of autonomy.

In detail, it appears NPS have different consequences on caregivers. Thus, we observe a negative impact of disruptive behavioral disorders such as agitation or irritability. Affective symptoms, anxiety and depression, also appear being difficult to manage for caregivers, as do psychotic symptoms. According to the International Psychogeriatric Association, delusions, hallucinations, depression and anxiety are among the most problematic NPS for family members.³²

In our study, disinhibition does not appear to be related to burden, unlike what has been shown in other publications.³³ This lack of correlation is possibly due to the low prevalence of this symptom in our sample and a lack of statistical power.

Surprisingly, apathy, considered a silent symptom, is the behavioral manifestation most strongly correlated with burden with a beta coefficient >0.4 ($p < 0.0001$). This high association between apathy

TABLE 3 Relationships between personality dimensions and total NPI score.

	Bêta	R ²	t	p	Confidence interval	
Neuroticism	0.254	0.197	3042	0.003	0.016	0.076
Extraversion	-0.088	0.149	-1094	0.276	-0.058	0.017
Opening	-0.134	0.157	-1552	0.123	-0.070	0.008
Agreeableness	-0.082	0.147	-0.904	0.368	-0.060	0.022
Conscientiousness	-0.233	0.191	-2863	0.005	-0.088	-0.016

Note: Linear regressions adjusted for age, gender, educational level and MMSE.

TABLE 4 Relationships between behavioral symptoms and caregiver burden.

	Bêta	R ²	t	p	Confidence interval	
NPIRG	0.450	0.223	5896	0.000	0.144	0.290
Delusional ideas	0.011	0.041	0.134	0.894	-0.759	0.869
Hallucinations	0.219	0.085	2802	0.006	0.707	4083
Agitation	0.290	0.120	3722	0.000	0.334	1089
Depression	0.217	0.087	2760	0.006	0.136	0.818
Anxiety	0.284	0.119	3771	0.000	0.261	0.834
Euphoria	-0.074	0.051	-0.949	0.344	-0.752	0.264
Apathy	0.394	0.188	5394	0.000	0.427	0.920
Disinhibition	0.147	0.064	1916	0.057	-0.018	1181
Irritability	0.297	0.128	4007	0.000	0.306	0.902
Aberrant motor behaviors	0.246	0.096	3102	0.002	0.323	1454
Sleep disorders	0.048	0.049	0.614	0.540	-0.339	0.645
Appetite disorders	0.064	0.048	0.820	0.413	-0.280	0.679

Note: Linear regressions adjusted for age, gender, socio-cultural level and MMSE.

TABLE 5 Relationships between personality dimensions and caregiver burden as measured by the mini-ZARIT.

	Bêta	R ²	t	p	Confidence interval	
Neuroticism	0.094	0.043	1066	0.288	-0.007	0.025
Extraversion	-0.185	0.068	-2240	0.027	-0.040	-0.003
Opening	0.025	0.035	0.275	0.784	-0.018	0.024
Agreeableness	-0.091	0.041	-0.974	0.332	-0.031	0.011
Conscientiousness	-0.235	0.086	-2802	0.006	-0.044	-0.008

Note: Linear regressions adjusted for age, gender, socio-cultural level and MMSE.

and burden has been observed in previous studies.^{8,34} Apathy is clinically characterized by a lack of verbal and motor initiative, an emotional blunting as well as a void of thought.³⁵ Patients with severe apathetic symptomatology require repetitive stimulation for everyday activities, which can lead to physical fatigue and disengagement of the caregiver. Furthermore, the emotional indifference that accompanies emotional blunting may also have negative psychological repercussions for the family members who will feel difficulties to interact with the patient. Pathophysiologically, apathy is considered a frontal dysfunction, which results in an inability to initiate motivated behaviors and inhibit automatic behaviors. Apathetic patients may therefore exhibit paradoxical reactions of aggression and irritability, particularly in response to over-stimulation. This unpredictability of behavior may contribute to management issues.

5.3 | Influence of patient's premorbid personality

5.3.1 | Premorbid personality and SNP

The main objective of our study was to investigate the relationship between premorbid personality dimensions and caregiver burden. It has already been shown that caregivers' personality and coping style influence their subjective experience of caring for their ill relative.⁹ To our knowledge, no previous research had been conducted on the personality of the patient himself. The impact of the patient's premorbid personality on burden may be direct or indirect via the modulating effect of personality on NPS. We therefore performed analyses in several steps by first assessing the link between personality and NPS, then between personality and burden, and finally by controlling for the link between personality and burden on NPS.

In the PACO study, previous longitudinal analyses have already shown a link between personality dimensions and the progression of NPS. High levels of neuroticism appeared to be a risk factor, whereas high levels of conscientiousness or openness were protective for NPS evolution.^{36,37} This differential impact of personality dimensions on NPS has been confirmed in other research.¹⁷ In the present study, our statistical analyses are based solely on cross-sectional data from the PACO study collected after 18 months of follow-up. They confirm a negative impact of neuroticism and a positive impact of conscientiousness on overall behavioral load. These results suggest an indirect impact of personality on burden through its influence on behavioral disorders.

5.3.2 | Premorbid personality and caregivers' burden

Personality may also have a direct impact on caregivers not mediated by NPS. After adjustment for age, sex, and educational level, our analyses revealed a significant negative relationship between the level of extraversion or conscientiousness and burden. These findings suggest that a lower extraversion and conscientiousness would be

related to a greater burden. On the other hand, the burden appeared to be independent of the patient's level of neuroticism and agreeableness.

A high level of extraversion is reflected in dynamism, ease in establishing relationships, great sociability, and a cheerful and enthusiastic disposition. Extraverted patients may have better coping and adaptive abilities with respect to their disease, and more adjusted interpersonal skills with their loved ones, which would contribute to limit the burden. Furthermore, the difficulties experienced by caregivers at home often depend on the acceptance of professional support.³⁸ The refusal of aids is regularly linked to the patient's lack of perception of their usefulness. In subjects with a high level of extraversion, the implementation of support could be facilitated, as well as participation in group activities such as day care centers, because of less psychological resistance.

A high conscientiousness is manifested by a higher degree of rigor, a greater sense of morality and better projection and anticipation abilities. This personality dimension is associated with better executive abilities and cognitive reserve.^{39,40} In case of AD, individuals with a high level of conscientiousness could maintain better abilities of adaptation and judgment, especially in the early stage of the disease, facilitating their integration and their interaction with their environment. Moreover, an indirect role of conscientiousness is also possible, knowing its association with less behavioral disorders.³⁶

5.4 | Strengths of the study

This study has several strengths. Unlike many other publications, the study sample is homogeneous in terms of cognitive status and the diagnosis of clinically probable AD is based on well-established criteria. Personality was comprehensively assessed with the NEO PI-R scale, considered the gold standard. In addition, the number of patients recruited ($N = 180$) is large.

5.5 | Limitations of the study

Some limitations should be taken into consideration. Personality assessment in neurodegenerative diseases may be compromised because of lack of awareness and recall bias. To improve the reliability of these assessments, it would have been interesting to combine a self-report measure with hetero-report by the caregiver.⁴¹ It is worthy to note that the evaluation by close relatives is supposed to be more objective, but can also be biased by the quality of the relationship with the patient and by the perceived burden.¹⁶ Some studies have shown that when patients suffering from mild AD are asked to describe their current personality, they tend to describe themselves as they were before the onset of the disease. This discrepancy that appears to be more pronounced for certain aspects of personality such as submissiveness and extraversion, can be interpreted as a difficulty in updating their self-image once affected by the disease. Our study focusing on the personality 5 years before

the onset of the disease suggests that the self-assessment of the patient can therefore be considered reliable.^{14,42}

Our results highlight a link between personality and NPS, NPS and burden, and personality and burden. In this context, the association between personality and burden may be direct or indirect, mediated by the behavioral troubles. The relationship between personality and burden didn't persist after controlling on behavioral troubles (total NPI), suggesting that behavioral disorders are more relevant than personality. Another limitation of this study is the absence of detailed information about the caregivers. Including more data on caregivers' age, gender, relationship to the care recipient, work activity, marital status, duration and frequency of caregiving, and any additional support they received would have enhanced the comprehensiveness of the study.

5.6 | Conclusion

Our findings highlight the influence of patient premorbid personality on caregiver burden in AD. Individuals with high levels of extraversion or conscientiousness appear to exhibit relational dispositions that facilitate caregiving, reduce family tension, and alleviate caregiver difficulties. Surprisingly, we found that neuroticism does not directly contribute to burden but rather indirectly through its negative impact on NPS. Understanding the influence of premorbid personality on SNP and caregiver burden is crucial for healthcare professionals. It enables them to identify caregivers be at higher risk of experiencing heightened stress. This understanding also aids in the development of targeted interventions tailored to the specific needs of caregivers. Tailored caregiver support programs, such as psychoeducation, respite care, and counseling, can be designed to address the challenges associated with different premorbid personality profiles. Assessing personality traits can help identify patients at risk of developing certain behavioral symptoms. This could contribute to anticipate these symptoms and assist relatives in developing effective management and coping strategies. Moreover, targeted interventions can also be developed to address the psychological and emotional needs of both the patient and the caregiver, thereby improving both the overall quality of life and the quality of care provided.

AUTHOR CONTRIBUTIONS

J. M. Dorey, P. Krolak-Salmon and I. Rouch conceived the idea, and manage the design of the study. E. Pongan et C. Padovan participated in the coordination of the study and the recruitment of the participants. J. M. Dorey and E. Pongan drafted the manuscript for submission. A. Chaillet, I. Rouch and M. Herrmann helped to the draft. All the author approved the final version of the manuscript.

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CONFLICT OF INTEREST STATEMENT

The author declare that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

Data concerning this article are available on request by contacting the principal author.

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REFERENCES

- O'Caomh R, Calnan M, Dhar A, Molloy DW. Prevalence and predictors of caregiver burden in a memory clinic population. *J Alzheimers Dis Rep.* 2021;5(1):739-747. <https://doi.org/10.3233/adr-201003>
- Pearlin LI, Mullan JT, Semple SJ, Skaff MM. Caregiving and the stress process: an overview of concepts and their measures. *Gerontol.* 1990;30(5):583-594. <https://doi.org/10.1093/geront/30.5.583>
- Koyama A, Matsushita M, Hashimoto M, et al. Mental health among younger and older caregivers of dementia patients. *Psychogeriatrics.* 2017;17(2):108-114. <https://doi.org/10.1111/psyg.12200>
- Chang H.-Y, Chiou C.-J, Chen N.-S. Impact of mental health and caregiver burden on family caregivers' physical health. *Arch Gerontol Geriatr.* 2010;50(3):267-271. <https://doi.org/10.1016/j.archger.2009.04.006>
- Gimeno I, Val S, Cardoso Moreno MJ. Relation among caregivers' burden, abuse and behavioural disorder in people with dementia. *Int J Environ Res Publ Health.* 2021;18(3):1263. <https://doi.org/10.3390/ijerph18031263>
- Kim B, Noh GO, Kim K. Behavioural and psychological symptoms of dementia in patients with Alzheimer's disease and family caregiver burden: a path analysis. *BMC Geriatr.* 2021;21(1):160. <https://doi.org/10.1186/s12877-021-02109-w>
- Dauphinot V, Ravier A, Novais T, Delphin-Combe F, Mouchoux C, Krolak-Salmon P. Risk factors of caregiver burden evolution, for patients with subjective cognitive decline or neurocognitive disorders: a longitudinal analysis. *J Am Med Dir Assoc.* 2016;17(11):1037-1043. <https://doi.org/10.1016/j.jamda.2016.07.003>
- Baharudin AD, Din NC, Subramaniam P, Razali R. The associations between behavioral-psychological symptoms of dementia (BPSD) and coping strategy, burden of care and personality style among low-income caregivers of patients with dementia. *BMC Publ Health.* 2019;19(S4):447. <https://doi.org/10.1186/s12889-019-6868-0>
- Vespa A, Spatuzzi R, Fabbietti P, Penna M, Giulietti MV. Association between care burden, depression and personality traits in Alzheimer's caregiver: a pilot study. *PLoS One.* 2021;16(9):e0251813. <https://doi.org/10.1371/journal.pone.0251813>
- Bangerter LR, Liu Y, Kim K, Zarit SH. Adult day services and dementia caregivers' daily affect: the role of distress response to behavioral and psychological symptoms of dementia. *Aging Ment Health.* 2021;25(1):46-52. <https://doi.org/10.1080/13607863.2019.1681934>
- Bonin-Guillaume S, Arlotto S, Blin A, Gentile S. Family caregiver's loneliness and related health factors: what can be changed? *Int J Environ Res Publ Health.* 2022;19(12):7050. <https://doi.org/10.3390/ijerph19127050>
- Steadman PL, Tremont G, Davis JD. Premorbid relationship satisfaction and caregiver burden in dementia caregivers. *J Geriatr Psychiatr Neurol.* 2007;20(2):115-119. <https://doi.org/10.1177/0891988706298624>

13. Welleford EA, Harkins SW, Taylor JR. Personality change in dementia of the Alzheimer's type: relations to caregiver personality and burden. *Exp Aging Res.* 1995;21(3):295-314. <https://doi.org/10.1080/03610739508253986>
14. Pocnet C, Rossier J, Antonietti J-P, von Gunten A. Personality changes in patients with beginning Alzheimer disease. *Can J Psychiatr.* 2011;56(7):408-417. <https://doi.org/10.1177/070674371110560704>
15. Lopes KF, Bahia VS, Natividade JC, et al. Changes in personality traits in patients with Alzheimer's Disease. *Dement Neuropsychol.* 2022;16(2):187-193. <https://doi.org/10.1590/1980-5764-dn-2021-0029>
16. Rhodes E, Mechanic-Hamilton D, Phillips JS, et al. Discrepancies in patient and caregiver ratings of personality change in Alzheimer's disease and related dementias. *medRxiv.* 2023;2023(03.09):23287003.
17. Sutin AR, Stephan Y, Luchetti M, Terracciano A. Self-reported personality traits are prospectively associated with proxy-reported behavioral and psychological symptoms of dementia at the end of life. *Int J Geriatr Psychiatr.* 2018;33(3):489-494. <https://doi.org/10.1002/gps.4782>
18. Osborne H, Simpson J, Stokes G. The relationship between premorbid personality and challenging behaviour in people with dementia: a systematic review. *Aging Ment Health.* 2010;14(5):503-515. <https://doi.org/10.1080/13607861003713208>
19. Rouch I, Dorey J, Boublay N, et al. Personality, Alzheimer's disease and behavioural and cognitive symptoms of dementia: the PACO prospective cohort study protocol. *BMC Geriatr.* 2014;14(1):110. <https://doi.org/10.1186/1471-2318-14-110>
20. Dubois B, Feldman HH, Jacova C, et al. Research criteria for the diagnosis of Alzheimer's disease: revising the NINCDS-ADRDA criteria. *Lancet Neurol.* 2007;6(8):734-746. [https://doi.org/10.1016/S1474-4422\(07\)70178-3](https://doi.org/10.1016/S1474-4422(07)70178-3)
21. Albert MS. Changes in cognition. *Neurobiol Aging.* 2011;32(suppl 1):S58-S63. <https://doi.org/10.1016/j.neurobiolaging.2011.09.010>
22. Folstein MF, Folstein SE, McHugh PR. 'Mini-mental state'. A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res.* 1975;12(3):189-198. [https://doi.org/10.1016/0022-3956\(75\)90026-6](https://doi.org/10.1016/0022-3956(75)90026-6)
23. Cummings JL, Mega M, Gray K, Rosenberg-Thompson S, Carusi DA, Gornbein J. The Neuropsychiatric Inventory: comprehensive assessment of psychopathology in dementia. *Neurology.* 1994;44(12):2308-2314. <https://doi.org/10.1212/wnl.44.12.2308>
24. Costa PT, McCrae RR. Revised NEO Personality Inventory (NEO PI-R) and NEO Five-Factor-Inventory (NEO-FFI) Professional Manual.
25. Kaufer DI, Cummings JL, Ketchel P, et al. Validation of the NPI-Q, a brief clinical form of the Neuropsychiatric Inventory. *J Neuropsychiatry Clin Neurosci.* 2000;12(2):233-239. <https://doi.org/10.1176/appi.neuropsych.12.2.233>
26. Zarit SH, Reever KE, Bach-Peterson J. Relatives of the impaired elderly: correlates of feelings of burden. *Gerontol.* 1980;20(6):649-655. <https://doi.org/10.1093/geront/20.6.649>
27. Gort AM, March J, Gómez X, de Miguel M, Mazarico S, Ballesté J. [Short Zarit scale in palliative care]. *Med Clin.* 2005;124(17):651-653. <https://doi.org/10.1157/13074742>
28. Benoit M, Staccini P, Brocker P, et al. [Behavioral and psychological symptoms in Alzheimer's disease: results of the REALFR study]. *Rev Med Interne.* 2003;24(suppl 3):319s-324s. [https://doi.org/10.1016/S0248-8663\(03\)80690-2](https://doi.org/10.1016/S0248-8663(03)80690-2)
29. Mukherjee A, Biswas A, Roy A, Biswas S, Gangopadhyay G, Das S. Behavioural and psychological symptoms of dementia: correlates and impact on caregiver distress. *Dement Geriatr Cogn Dis Extra.* 2017;7(3):354-365. <https://doi.org/10.1159/000481568>
30. Lima-Silva TB, Bahia VS, Carvalho VA, et al. Neuropsychiatric symptoms, caregiver burden and distress in behavioral-variant frontotemporal dementia and Alzheimer's disease. *Dement Geriatr Cogn Disord.* 2015;40(5-6):268-275. <https://doi.org/10.1159/000437351>
31. Leggett AN, Zarit S, Taylor A, Galvin JE. Stress and burden among caregivers of patients with Lewy body dementia. *Gerontol.* 2011;51(1):76-85. <https://doi.org/10.1093/geront/gnq055>
32. Finkel SI, Costa eSJ, Cohen G, Miller S, Sartorius N. Behavioral and psychological signs and symptoms of dementia: a consensus statement on current knowledge and implications for research and treatment. *Int Psychogeriatr.* 1996;8(suppl 3):497-500. <https://doi.org/10.1017/s1041610297003943>
33. Kameoka N, Sumitani S, Ohmori T. Behavioral and psychological symptoms of dementia (BPSD) and care burden: Examination in the facility staff for elderly residents. *J Med Invest.* 2020;67(3.4):236-239. <https://doi.org/10.2152/jmi.67.236>
34. Gómez-Gallego M, Gómez-Gallego JC. Predictors of caregiver burden of patients with alzheimer disease attending day-care centres. *Int J Environ Res Publ Health.* 2021;18(20):10707. <https://doi.org/10.3390/ijerph182010707>
35. Marin RS. Apathy: a neuropsychiatric syndrome. *J Neuropsychiatry Clin Neurosci.* 1991;3:243-254.
36. Rouch I, Dorey J-M, Padovan C, et al. Does personality predict behavioral and psychological symptoms of dementia? Results from PACO prospective study. *J Alzheimers Dis.* 2019;69(4):1099-1108. <https://doi.org/10.3233/jad-190183>
37. Dorey J, Rouch I, Padovan C, et al. Neuroticism-withdrawal and neuroticism-volatility differently influence the risk of neuropsychiatric symptoms in alzheimer's disease. *J Alzheimers Dis.* 2020;74(1):79-89. <https://doi.org/10.3233/jad-190884>
38. Zwingmann I, Dreier-Wolffgramm A, Esser A, et al. Why do family dementia caregivers reject caregiver support services? Analyzing types of rejection and associated health-impairments in a cluster-randomized controlled intervention trial. *BMC Health Serv Res.* 2020;20(1):121. <https://doi.org/10.1186/s12913-020-4970-8>
39. Fleming KA, Heintzelman SJ, Bartholow BD. Specifying associations between conscientiousness and executive functioning: mental set shifting, not prepotent response inhibition or working memory updating. *J Pers.* 2016;84(3):348-360. <https://doi.org/10.1111/jopy.12163>
40. Oosterman JM, Jansen MG, Scherder EJA, Kessels RPC. Cognitive reserve relates to executive functioning in the old-old. *Aging Clin Exp Res.* 2021;33(9):2587-2592. <https://doi.org/10.1007/s40520-020-01758-y>
41. Ruby P, Collette F, D'Argembeau A, et al. Perspective taking to assess self-personality: what's modified in Alzheimer's disease? *Neurobiol Aging.* 2009;30(10):1637-1651. <https://doi.org/10.1016/j.neurobiolaging.2007.12.014>
42. Rankin KP, Baldwin E, Pace-Savitsky C, et al. Self awareness and personality change in dementia. *J Neurol Neurosurg Psychiatr.* 2005;76(5):632-639. <https://doi.org/10.1136/jnnp.2004.042879>

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