Psychosocial correlates of nutritional status of family caregivers of persons with dementia

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Abstract

Background: This exploratory study investigated the associations of individual characteristics of both persons with dementia and family caregivers with the nutritional status of caregivers. **Methods:** This cross-sectional study was conducted at home by psychogerontologist within the frame of a community gerontological center in rural areas of south west France. The study participants comprised fifty-six community-dwelling persons with dementia (mean 80.7 years, SD 6.5) and fifty-six family caregivers (mean 70.9 years, SD 11.0). Persons with dementia were assessed with Mini Mental State Examination (MMSE), Basic activities of daily living (ADL), Instrumental ADL (IADL), and NeuroPsychiatric Inventory (NPI), and family caregivers with the Burden Interview (Zarit scale), the State-Trait Anxiety Inventory (STAI Y-B), the Center for Epidemiologic Studies Depression Scale (CES-D), the emotional impact measure of NPI and the Autonomy, Gerontology and Group Resources scale (AGGIR scale). For both, nutritional status was evaluated using the Mini Nutritional Assessment (MNA®). **Results:** Among family caregivers, 32.1% were at risk of malnutrition and 5.4% were malnourished, and among people with dementia, 58.9% and 23.2% respectively. NPI severity score of apathy of persons with dementia (Beta=-0.342, p=0.001), dependency on AGGIR scale (Beta=-0.336, p=0.002) and CES-D score of caregivers (Beta=-0.365, p=0.001) were associated with caregivers' MNA score (Adjusted R^2=0.480, p<0.001).

Conclusion: These preliminary findings emphasize the need for routine assessment of depressive symptoms, functional and nutritional status in dementia family caregivers and confirm the value of investigating caregivers' nutritional risk through an integrative view including psychosocial approach.

Key-words: family caregiver, nutritional status, dementia, psychosocial factors, community

Running Head: Dementia caregivers' nutritional status correlates

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Introduction

The majority of people with dementia living in the community receive assistance directly from family caregivers (Schulz and Martire, 2004), which are family members, primarily older spouses, followed by middle-age or older adult children (Brodaty and Donkin, 2009). Providing daily care for a relative suffering from dementia is stressful and particularly burdensome to many family caregivers. Thus, caregiving is considered as a chronically stressful process with potentially negative mental and physical health consequences (Pearlin *et al*., 1990; Vitaliano *et al*., 2003), including high levels of burden, depression and anxiety (e.g., Schulz *et al*., 1995) and also poor nutritional status (Vitaliano *et al.*, 1996; 2003).

Poor nutrition is a frequent condition among older adults. A recent retrospective pooled analysis estimates that 5.8% of elderly people living at home are malnourished and 31.9% are at risk of malnutrition (Kaiser *et al*., 2010), based on the Mini Nutritional Assessment (MNA®) (Vellas *et al.*, 1999). This tool has been initially validated to identify elderly people at risk of malnutrition and permits a comprehensive global nutritional assessment (Vellas *et al.*, 1999). However, caregivers are not only older spouses but also middle-aged individuals for whom few data are available. In the single relevant study to our knowledge concerning caregivers' nutritional status, 21% of family caregivers were at risk of malnutrition (Torres *et al.*, 2010).

Indeed, while a broad range of psychological and physical health outcomes has been examined (e.g. Schulz *et al.*, 1995; Pinquart and Sorensen, 2007; Schulz and Sherwood, 2008), only one study has reported risk of malnutrition in primary family caregivers aged 50 years or over (Torres *et al.*, 2010), based on the MNA®. This study revealed that the caregivers who had depressive symptoms were more likely to present a poor nutritional status;

their unique findings underlined the interplay between depression and malnutrition in family caregivers. However, this study has not consider the caregiving dyad, and in particular characteristics of the care recipient.

In a recent paper (Rullier *et al*., 2013), we suggested that more explanatory research is needed to identify factors associated with the nutritional status of caregivers of persons with dementia through an integrative and psychosocial approach including characteristics related to caregiver and care recipient. Indeed, based on the theoretical framework of caregiving as a stressful process, compromised nutritional status in dementia family caregiver could be investigated as a detrimental health effect of caregiving (Fredman, 1998; Vitaliano *et al*., 2003). Thus, the determinants of caregiver's health, related to the burden of care, would encompass individual characteristics of the person with dementia including cognitive, neuropsychiatric and functional status considered as stressors (e.g., Vitaliano *et al*., 1991; Schulz *et al*., 1995; Black and Almeida, 2004), and individual characteristics of the caregivers including age, sex, co-residence, relationship with their relative with dementia, their functional status and also psychological distress (e.g., Pinquart and Sorensen, 2007; Schulz and Sherwood, 2008).

This exploratory study aimed to investigate the associations of individual characteristics of both family caregiver (i.e. burden, anxiety, depression, emotional impact of behavior disorders and functional status) and elderly people with dementia (i.e. cognitive, functional, neuropsychiatric and nutritional status) with the nutritional status of caregivers.

Methods

Participants and data collection

This cross-sectional study is part of a pilot study based on psychosocial interventions, with older people with dementia and family caregivers within the frame of a community gerontological center in rural areas of south west France. The data collected included sociodemographic information and measures of physical and mental health of caregiving dyad. This pilot study was approved by the Ethics Committee of the CHU (Centre Hospitalo-Universitaire) of Bordeaux according to the principles embodied in the Declaration of Helsinki.

Our sample consisted in 56 persons with dementia and 56 family caregivers who participated in the pilot study (for more details on the design, see Rullier *et al.*, 2013). Persons with dementia were included when they: i) met the criteria for dementia according to the DSM-IV criteria (DSM-IV-TR) (American Psychiatric Association, 2000); ii) lived at home; iii) had a responsible caregiver who lived with them or visited them several times a week. In addition, the family caregivers did not have to receive previously a dementia or psychiatric diagnosis. These information were verified with their general practitioner. Informed consent was obtained from older people with dementia and from their caregiver.

Measures

Characteristics of older people with dementia

Sociodemographic variables included age, sex, education level. Global cognitive functioning was examined using the Mini Mental State Examination (MMSE) (Folstein *et al.*, 1975). Functional status was measured with Lawton's scale of Instrumental Activities of Daily Living (IADL) (Lawton and Brodie, 1969) considering only the four IADL strongly associated with the presence of dementia: phone use, transportation use, taking medication, and handling finances (Barberger-Gateau *et al.*, 1999). A participant was considered as "dependent" for each of these activities if he or she could not perform the activity at the highest level of performance. We then computed the 4 IADL score adding the number of IADLs for which the subject is considered to be 'dependent' (ranging from 0 to 4). As we were interested by activities related to food, we considered independently the 'shopping' activity as measured in the Lawton's scale i.e. with a score ranging from 1 (independent) to 4 (totally dependent). Functional status was also assessed using Katz's scale for Activities of Daily Living (ADL) (Katz *et al*., 1970). Continence was not considered in this paper because difficulties in bladder or bowel control reflect an abnormality in a particular physical system, and should therefore be considered as an impairment rather than a disability (Spector, 1990). We computed a 5 ADL score adding the number of ADLs for which the subject is considered to be 'dependent' (ranging from 0 to 5) based on threshold defined by Katz *et al.* (1970). The NeuroPsychiatric Inventory (NPI) (Cummings *et al*., 1994) was used to identify what types of Behavioral and Psychological Symptoms of Dementia (BPSD) were associated with nutritional status of caregivers. The severity score (frequency X Severity) for each symptom, ranging from 0 to 12, was considered rather than the total score. Because BPSD are considered as the most distressing factors (e.g. Schulz *et al*., 1995; Black and Almeida, 2004; Schulz and Sherwood, 2008), we wanted to examine the impact of each BPSD on caregiver's nutritional status in order to identify the most detrimental for caregivers' nutritional status. Therefore, we did not exclude *a priori* any NPI subscale. Nutritional status was measured with the MNA® (Vellas *et al*., 1999). With a range score from 0 to 30, this quick and non-invasive scale consists in 18 items including anthropometric measurements (body mass index, mid-arm and calf circumference, weight loss), dietary information (number of meals consumed, frequency of food and fluid intake and feeding autonomy), a general assessment (life-style, medication, mobility, presence of acute stress and presence of dementia or depression) and a self-perception measure (self-rated health and nutrition). An MNA score < 17 indicates malnutrition, a score between 17 and 23.5 indicates a risk of malnutrition and a score ≥ 24 reflects a good nutritional status (Vellas *et al*., 1999). Functional, neuropsychiatric, and nutritional assessments were based on structured questionnaires administered to the family caregiver.

Characteristics of family caregivers

Sociodemographic data included age, sex, education level, caregiver relationship with person with dementia and living arrangements (living with or without the patient). Trait anxiety was assessed by the State-Trait Anxiety Inventory form Y/Trait Scale (STAI Y-B) (Spielberger *et al*., 1983). Depressive symptoms were evaluated using the Center for Epidemiologic Studies Depression Scale (CES-D) (Radloff, 1977). The Zarit Burden Interview evaluates caregiver burden (Zarit *et al*., 1983). Emotional impact related to each BPSD on caregivers was measured with the NPI. Functional status was evaluated using the AGGIR scale (Autonomy, Gerontology and Group Resources scale) (Vetel *et al*., 1998), a French standardized instrument, assessing eight measures of ADL limitations and two additional measures of intellectual coherence and orientation and resulting on a classification in 6 degrees of dependency (Group resources: GIR 1 to GIR 6). Because GIR 1, 2, 3 and 4 corresponds to very severe at moderate dependency and GIR 5 and 6 to mild and absence of dependency, the functional status was divided into two levels as follows: dependent (GIR≤ 4) or not dependent level (GIR > 4). As in another study in caregivers aged 50 years and over (Torres *et al*., 2010), caregivers' nutritional status was also assessed with the MNA® (Vellas *et al*., 1999), as most of them were aged and in order to use similar tools in the patient with dementia and his/her caregiver.

Statistical analyses

The MNA can be used as a categorical (normal, at risk of malnutrition and malnourished) or continuous variable (range score from 0 to 30) (Romero-Ortuno *et al*., 2011). We used both the MNA score as a categorical variable to describe the nutritional status and as a continuous variable in regression analyses. The MNA score of caregivers as a continuous variable was considered as the dependent variable.

Our analyses comprised several steps to select the significant variables included in the final stepwise model as the main explanatory variables of variation of caregivers' MNA score. So we conducted the following analyses: (i) a set of univariate linear regressions with all variables of persons with dementia and those of caregivers as separate independent variables; (ii) two separate multiple linear regressions to test the relationship between the MNA score and significant variables of the older people with dementia on the one hand, and significant variables of caregivers on the other hand, based on the previous set of univariate analyses, with a forward stepwise procedure; (iii) a single multiple linear regression to test the relationship between the caregivers' MNA score and the significant variables of both persons with dementia and caregivers selected from the two previous multiple regression models. These variables were introduced in this final model with a forward stepwise procedure.

Thus, each of the multiple linear regressions was conducted with a forward stepwise procedure which was based on the sequential introduction of variables. Each explanatory variable was tested for entry into the model one by one, based on the significance level of the likehood-ratio statistic ($p < 0.05$). The variable with the strongest Beta and with the smallest significance level is the first entered into the model, improving the model the most, and repeating this process until none improves the model. The normality of the distribution of continuous variables was established with the Kolmogorov-Smirnov test and homoscedasticity and normality of the distribution of residuals were verified. The significance level of $p < 0.05$ was considered for all statistical analyses. All statistical analyses were performed with IBM® SPSS® 18.0 (SPSS®, 2009).

Results

The demographic and clinical characteristics of persons with dementia are presented in Table 1 and those of family caregivers in Table 2. The mean score of MNA was 24.4 ± 4.2 for the family caregivers and 19.8 ± 5.4 for the persons with dementia. Among caregivers, 32.1%

were at risk of malnutrition and 5.4% were malnourished. Our results showed that 58.9% of elderly people with dementia were at risk of malnutrition and 23.2% were malnourished.

Insert Tables 1 and 2 about here

In univariate analyses, the characteristics of persons with dementia significantly associated with the MNA score of family caregivers were MNA score, 5 ADL score and NPI severity score of hallucinations, agitation/aggression and apathy (Table 1). The variables of caregivers significantly associated with their MNA® score were age, education level, dependency level on AGGIR scale, CES-D, STAI Y-B and Zarit scale scores, and NPI emotional impact scores of hallucinations, dysphoria/depression, apathy and aberrant motor behavior (Table 2).

The first multiple linear regression analysis, including only significant variables of persons with dementia selected previously from univariate analysis (table 1), showed that MNA score and NPI severity score of apathy significantly explained 23% of variation of MNA score of caregivers (Table 3). For the second multiple linear regression analysis including only significant variables of caregivers selected previously from univariate analysis (table 2), dependency on AGGIR scale, CES-D score and NPI emotional impact of hallucinations significantly explained 43% of variation of MNA score of caregivers (Table 3).

Insert Table 3 about here

In the final multiple linear regression analysis, significant variables selected from the previous multiple linear regression analyses of both people with dementia (MNA score and NPI severity score of apathy) and caregivers (functional status level on AGGIR scale, CES-D score and NPI emotional impact of hallucinations) were introduced as explanatory variables.

Considering the inclusion of five predictors in this model, a power analysis ensured that the current sample provided a statistical power above 0.96. Using a forward stepwise procedure, the first variable introduced in the model was CES-D, because it was the strongest variable associated with caregiver's MNA score. The following variables introduced were the severity of apathy then the level of dependency, both of which contributed also to the final model such as CES-D. Thus, in this final model, NPI severity score of apathy of persons with dementia, dependency level on AGGIR scale and CES-D score of caregivers significantly explained 48% of variation of caregivers' MNA score (Table 4).

Insert Table 4 about here

Discussion

In our sample of community-dwellers, the prevalence of poor nutritional status was very high in both the older people with dementia and their family caregiver. This finding revealed that 37.5% of caregivers presented a compromised nutritional status. Our results confirmed the presence of nutritional risk in community-dwelling caregivers shown also by Torres *et al*. (2010). However, in their study, 21.1% of caregivers were at risk of malnutrition but the medical condition of the person receiving the care was not considered. Our sample was composed of caregivers of elderly people with dementia, who are identified as a particularly vulnerable population (Vitaliano *et al*., 2003).

Regarding factors related to persons with dementia, our results showed a strong association between the severity of apathy and caregivers' nutritional status. These findings confirmed the link between the physical health of caregivers and BPSD (Schulz *et al*., 1995), especially with the negative symptoms such as apathy that is particularly burdensome (Thomas *et al*., 2001). Indeed, apathy leads to less participation in activities of daily living and may require intensive stimulation by the caregiver. Moreover, caregivers often have limited knowledge about the symptoms of dementia. As a consequence, they may have difficulty in interpreting their relative's behavior, especially during mealtime (Mamhidir *et al*., 2007). Finally, we can hypothesize that these caregiving dyad's difficulties could affect their mealtime interactions: for example, apathy could weaken emotional and social exchanges within the caregiving dyad during mealtime, thus compromising psychosocial function of eating with others (Keller *et al*., 2010).

Regarding factors related to caregivers, our result showed that a poor nutritional status is strongly associated with depressive symptoms and higher level of dependency. This study confirmed the association between depressive symptoms and risk of malnutrition among family caregivers (Torres *et al*., 2010). Poor appetite is an item of both the CES-D and the MNA, thus explaining in part their association. However, the link between depression and appetite is controversial. Indeed, depression could be positively or negatively associated with appetite and weight (Torres *et al*., 2010). Although depression and functional limitations have been shown to be associated among family caregivers (Covinsky *et al*., 2003), our study shows that both are independently associated with their nutritional status. Otherwise, caregivers with poor physical health have probably more difficulties to withstand the physical demands of caregiving (Covinsky *et al*., 2003). These difficulties may increase the burden of care and psychological distress, thus inducing a vicious circle. Finally, future studies could investigate what kind of functional limitations are more associated with risk of malnutrition, especially if they lead to social deprivation which is well known as caregivers' distress factor (Vitaliano *et al*., 1991).

Taking simultaneously into account factors that are related to both persons with dementia and their caregivers better explained the risk of malnutrition in the family caregivers than each group of factors considered separately, as shown by the adjusted R^2. We found that the most highly depressive and dependent caregivers and those whose person with dementia presents severe apathy are the most at risk of malnutrition. Theses novel findings are in agreement with Thomas *et al* (2006) who proposed that the vulnerability of the caregiver is related both to individual factors and pathological conditions he/she must cope with. Studies that examine nutritional issues in dementia should consider caregiving dyad's relationship and in particular during mealtime, because their quality is recognized as an essential factor to improve nutritional status of persons with dementia (Aselage and Amella, 2010). We can hypothesize that it also important for the caregivers' nutritional status. This suggests that interventions should concern the community-dwelling caregiving dyad in order to improve their quality of life.

This study has some limitations. The specificity of our recruitment explains the limited size and the clinical characteristics of our sample. We cannot exclude that some associations could not be evidenced because of lack of power in this small sample. Thus, these findings cannot be generalized and require replication and confirmation in larger samples in various settings. Indeed, the caregiving dyads were not recruited in care center but through a community gerontological center and, they already presented some vulnerability due to the course of the disease. Moreover, living in rural areas could increase the nutritional deficiencies because of limited accessibility to food shops and lack of public transportation. In order to better understand risk factors for malnutrition in the context of dementia, it seems important to consider the dwelling environment, other contextual factors such as formal or informal support and also dietary habits and other nutritional measures, such as eating behaviors and sharing mealtime with the care recipient, which were not available in our study. Finally, the cross-sectional design of this study prevents the detection of causal relationship between psychosocial factors and caregivers' risk of malnutrition.

Conclusion

The factors associated with nutritional status of caregivers involve both their individual characteristics, i.e. their functional status and depressive symptoms, and those of their relatives suffering from dementia, i.e. the severity of apathy. These preliminary results confirmed the relationship between risk of malnutrition of the family caregiver and factors related to burden of care. These findings demonstrate the importance of paying more attention to these risk factors of malnutrition in dementia family caregivers. In particular, they emphasize the need for routine assessment of their depressive symptoms, functional and nutritional status, in order to prevent their potential detrimental impact on the caregiving dyad's quality of life. Future prospective researches are needed to better understand caregivers' risk of malnutrition in the context of dementia and should investigate this issue through an integrative view including psychosocial approach.

Conflict of interest

Marion Torres received phD financial support from Nutricia France.

Description of authors' roles

Laetitia Rullier contributed to study design, to data collection and data analysis, and wrote the paper. Alexia Lagarde supervised the community gerontological center staff, participated in the design of the study and in data collection. Valérie Bergua contributed to draft and to revise the manuscript. Jean Bouisson supervised the study. Marion Torres contributed to revise the manuscript. Pascale Barberger-Gateau participated in the study design, the statistical analyses and in drafting and revising the paper.

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Table legends

Table 1. Associations between characteristics of persons with dementia (Independent variables) and nutritional status of family caregivers (MNA® score as dependent variable).Univariate linear regression analyses, n = 56

Table 2. Associations between characteristics of family caregivers (Independent variables) and their nutritional status (MNA® score as dependent variable). Univariate linear regression analyses, n = 56

Table 3. Two separate multiple regression models of nutritional status of family caregivers with variables of persons with dementia and of caregivers, n = 56

Table 4. Final multiple regression model of nutritional status of family caregivers, N = 56

Table 1. Associations between characteristics of persons with dementia (Independent variables) and nutritional status of family caregivers (MNA® score as dependent variable).Univariate linear regression analyses, n = 56

VARIABLES OF PERSONS WITH DEMENTIA	MEAN, SD or n (%)	UNIVARIATE LINEAR REGRESSION ANALYSES		
		ADJUSTED R^2	BETA	p-VALUE
Age, mean (SD)	80.7 (6.5)	0.052	-0.263	0.050
Sex, n (%)				
Male (ref)[a]	32 (57)	-0.015	0.062	0.650
Female	24 (43)			
Education level[1], n (%)				
Low (ref)[a]	46 (82)	0.006	0.154	0.258
Medium, high	10 (18)			
MNA®[2] score, mean (SD)	19.8 (5.4)	0.131	0.383	**0.004**
Good nutritional Status (MNA ≥ 24)	10 (17.9)			
Status at risk of malnutrition (MNA17 - 23.5)	33 (58.9)			
Poor nutritional status (MNA < 17)	13 (23.2)			
MMSE[3] score mean, (SD)	16.5 (7.7)	0.013	0.175	0.198
4 IADL[4] score, mean (SD)	3.6 (0.7)	0.001	-0.140	0.304
Shopping IADL[5] score, mean (SD)	3.2 (0.9)	0.039	-0.237	0.078
5 ADL[6] score, mean (SD)	2.0 (1.9)	0.064	-0.284	**0.034**
NPI[7] Subscales (FxS scores)				
Delusions, mean (SD)	2.3 (3.9)	-0.003	-0.144	0.288
n (%) presence of symptom	19 (33.9)			
Hallucinations, mean (SD)	1.2 (2.6)	0.057	-0.272	**0.042**
n (%) presence of symptom	13 (23.2)			
Agitation / Aggression, mean (SD)	2.6 (3.6)	0.060	-0.277	**0.038**
n (%) presence of symptom	25 (44.6)			
Dysphoria / Depression, mean (SD)	2.6 (3.4)	-0.010	-0.092	0.500
n (%) presence of symptom	33 (58.9)			
Anxiety, mean (SD)	2.5 (3.6)	-0.001	-0.131	0.336
n (%) presence of symptom	32 (57.1)			
Euphoria, mean (SD)	0.2 (1.1)	-0.012	0.089	0.345
n (%) presence of symptom	3 (5.4)			
Apathy, mean (SD)	6.6 (3.8)	0.187	-0.449	**0.001**
n (%) presence of symptom	51 (91.1)			
Disinhibition, mean (SD)	0.5 (1.5)	-0.017	-0.177	0.287
n (%) presence of symptom	11 (19.6)			
Irritability / Lability, mean (SD)	1.9 (3.1)	-0.002	-0.129	0.344
n (%) presence of symptom	20 (35.7)			
Aberrant motor behavior, mean (SD)	2.9 (3.9)	-0.002	-0.142	0.295
n (%) presence of symptom	26 (46.4)			
Night-time disturbance, mean (SD)	1.3 (2.8)	0.018	-0.189	0.163
n (%) presence of symptom	15 (26.8)			
Appetite / eating disturbance, mean (SD)	2.4 (3.7)	0.029	-0.216	0.110
n (%) presence of symptom	22 (39.3)			

Note: [a] Reference group for the analysis; Statistically significant data p values were highlighted in bold.

[1] Education level was divided into two levels as follows: low level which corresponds to participants without schooling or having only obtained the French 'Certificat d'Etudes Primaires', equivalent to seven years of schooling; and medium / high level which corresponds to participants with a higher education level; [2]MNA® = Mini Nutritional Assessment; [3]MMSE = Mini Mental State Examination; [4] IADL score = number of Instrumental Activities in Daily Living for which the subject is considered to be 'dependent' (ranging from 0 to 4), for each domain = percentage of dependence ; [5] Shopping IADL score = as used in Lawton scale i.e. ranging from 1 to 4; [6]ADL score = number of Activities of Daily Living for which the subject is considered to be 'dependent' (ranging from 0 to 5), for each domain = percentage of dependence ; [7]NPI = NeuroPsychiatric Inventory.

Table 2. Associations between characteristics of family caregivers (Independent variables) and their nutritional status (MNA® score as dependent variable). Univariate linear regression analyses, n = 56

VARIABLES OF FAMILY CAREGIVERS	MEAN, SD or n (%)	UNIVARIATE LINEAR REGRESSION ANALYSES		
		ADJUSTED R^2	BETA	p-VALUE
Age, mean (SD)	70.9 (11.0)	0.097	-0.337	**0.011**
Sex, n (%)				
Male (ref) [a]	15 (27)	-0.007	-0.106	0.438
Female	41 (73)			
Education level, n (%)				
Low (ref) [a]	34 (60.7)	0.141	0.396	**0.003**
medium / high	22 (39.3)			
Relationship with patient, n (%)				
Spouse (ref) [a]	39 (69.6)	0.015	0.181	0.183
Children	12 (21.4)			
Others relatives	5 (9.0)			
Living with patient (yes), n (%)	46 (82)	-0.002	-0.126	0.355
MNA®[1] total score, mean (SD)	24.4 (4.2)	NA[c]	NA[c]	NA[c]
Good nutritional status (MNA ≥ 24)	35 (62.5)			
Status at risk of malnutrition (MNA17 - 23.5)	18 (32.1)			
Poor nutritional status (MNA < 17)	3 (5.4)			
AGGIR scale[2], n (%)				
GIR >4 (ref) a	8 (14.3)	0.203	-0.467	**0.000**
GIR ≤4	48 (85.7)			
Stai Y-B[3], mean (SD)	45.4 (3.4)	0.209	-0.472	**0.000**
CES-D[4], mean (SD)	17.2 (12.5)	0.282	-0.543	**0.000**
Zarit[5] scale, mean (SD)	34.1 (15.4)	0.167	-0.427	**0.001**
NPI subscales[6] (Emotional impact scores)				
Delusions, mean (SD)	1.1 (1.6)	-0.015	-0.055	0.688
n (%) presence of impact [b]	19 (100)			
Hallucinations, mean (SD)	0.6 (1.3)	0.100	-0.341	**0.010**
n (%) presence of impact [b]	12 (92.3)			
Agitation / Aggression, mean (SD)	1.6 (1.9)	0.032	-0.223	0.099
n (%) presence of impact [b]	25 (100)			
Dysphoria / Depression, mean (SD)	1.9 (1.8)	0.056	-0.271	**0.043**
n (%) presence of impact [b]	32 (97.0)			
Anxiety, mean (SD)	1.8 (1.8)	-0.014	-0.066	0.630
n (%) presence of impact [b]	30 (93.7)			
Euphoria, mean (SD)	0.2 (0.7)	-0.009	0.097	0.424
n (%) presence of impact [b]	3 (100)			
Apathy, mean (SD)	2.9 (1.4)	0.055	-0.268	**0.045**
n (%) presence of impact [b]	51 (100)			
Disinhibition, mean (SD)	0.6 (1.4)	-0.028	-0.127	0.438
n (%) presence of impact [b]	11 (100)			
Irritability / Lability, mean (SD)	1.3 (1.9)	-0.011	-0.087	0.524
n (%) presence of impact [b]	20 (100)			
Aberrant motor behavior, mean (SD)	1.3 (1.6)	0.096	-0.336	**0.011**
n (%) presence of impact [b]	26 (100)			
Night-time disturbance, mean (SD)	1.0 (1.7)	0.036	-0.231	0.087
n (%) presence of impact [b]	15 (100)			
Appetite/eating disturbance, mean (SD)	1.0 (1.6)	0.015	-0.180	0.184
n (%) presence of impact [b]	19 (89.4)			

Note: [a] Reference group for analysis; [b] If presence of symptom, the presence of an emotional impact was considered as a categorical variable: (0) absence of emotional impact corresponding to score = 0; (1) presence of emotional impact corresponding to score > 0; [c] Not Appropriate. Statistically significant data p values were highlighted in bold.

[1] MNA® = Mini Nutritional Assessment; [2] Level of dependency on AGGIR scale: GIR > 4 = 0 (independency); GIR ≤4 = 1 (dependency), [3] STAI Y-B = State-Trait Anxiety Inventory form Y / Trait Scale; [4] CES-D = Center for Epidemiologic Studies Depression Scale with scores ranging; [5] Zarit scale = Zarit Burden Interview; [6] NPI = NeuroPsychiatric Inventory.

Table 3. Two separate multiple regression models of nutritional status of family caregivers with variables of persons with dementia and of caregivers, n = 56

VARIABLES	ADJUSTED R^2	F VALUE	D.F.	p-VALUE	BETA	p-VALUE	95% CI[5]
Model 1 with variables of persons with dementia [a]	0.230	9.203	2.53	0.001			
MNA®[1] score					0.255		
NPI[2] severity score of					-0.337	0.050	0.000 ~ 0.395
apathy						0.007	-0.683 ~ -0.151
Model 2 with variables of family caregivers [b]	0.435	15.096	3.52	0.000			
Dependency AGGIR[3]					-0.350	0.002	1.639 ~ 6.761
CES-D[4] score					-0.389	0.001	-0.210 ~ -0.059
NPI emotional impact score of hallucinations					-0.266	0.013	-1.575 ~ -0.195

Note: Dependent variable = MNA® (Mini Nutritional Assessment) score of family caregivers.

[1] MNA (Mini Nutritional Assessment); [2] NPI (NeuroPsychiatric Inventory); [3] level of dependency on AGGIR scale: GIR > 4 = 0 (independency); GIR ≤4 = 1 (dependency); [4] CES-D: Center for Epidemiologic Studies Depression; [5] 95% CI = 95% Confidence Interval.

Table 4. Final multiple regression model of nutritional status of family caregivers, N = 56

VARIABLES	ADJUSTED R^2	F VALUE	D.F.	p-VALUE	BETA	p-VALUE	95% CI[4]
Model[a]	0.480	17.891	3.52	0.000			
NPI[1] FxS score of apathy					-0.342	0.001	-0.606 ~ -0.158
Dependency AGGIR[2]					-0.336	0.002	1.574 ~ 6.482
CES-D[3] score					-0.365	0.001	-0.199 ~ -0.054

[a] This model test the relationship between the MNA® score of caregivers (dependent variable) and the characteristics of both persons with dementia and caregivers selected from the two previous multiple linear regressions.

[1] NPI (NeuroPsychiatric Inventory); [2] level of dependency on AGGIR scale: GIR > 4 = 0 (independency); GIR ≤4 = 1 (dependency); [3] CES-D: Center for Epidemiologic Studies Depression; [4] 95% CI = 95% Confidence Interval.