Cognition and its association with the factors of the EURO-D: Suffering and Motivation. Findings from SHARE Wave 6.

Running title: Cognition and EURO-D factor structure in SHARE

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Key points:

● Poor cognition was associated with older age, lower educational levels, higher economic difficulties and higher depression levels.

● The depression scale (EURO-D) scores were associated with higher levels of loneliness, poorer self-perceived physical health, female gender and poor cognition.

● Poor cognition was associated only with the Motivation factor (EURO-D), while the female gender had a strong significant association with the Suffering factor (EURO-D).

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Abstract

Objective: The aims of this study were: 1) to analyse the relationship between cognition and clinical and sociodemographic variables; 2) to explore the relationship between cognitive tests and factors of EURO-D depression scale (Suffering and Motivation); and 3) to determine the relevance of cognition with respect to clinical and sociodemographic variables in the scores of the EURO-D factors.

Method: 63,755 participants in the Survey of Health, Ageing and Retirement in Europe (SHARE) Wave 6 (2015) were included. Instruments: the SHARE study, the EURO-D scale and cognitive tests. Bivariate, correlation and multiple linear regression analyses were performed.

Results: In the regression analysis with cognition, the variables associated with poor cognition were higher age (β = 0.29), lower educational level (β = -0.26), economic difficulties (β = 0.17) and depression (β = 0.10). The correlation between cognition and EURO-D factors was weak in Suffering (r = -0.139) and moderate in Motivation (r = -0.382). In the regression analysis with the EURO-D, loneliness, poor self-perceived physical health, female gender and low cognition were associated with higher depression levels. The main differences in the predictor variables of each factor were cognition (Motivation = -0.248, p <0.001; Suffering = 0.002, p = 0.648) and the female sex (Motivation = 0.015, p <0.001, Suffering = 0.175, p <0.001).

Conclusions: In the EURO-D depression scale, poor cognition was associated with higher scores in the Motivation factor only, while the female gender presented higher scores in the Suffering factor.

Keywords: Cognition, EURO-D, depressive symptoms, ageing, SHARE, factor analysis

1 INTRODUCTION

Due to the ageing population and the increased risk of dementia associated with older age, there is a growing interest in understanding how cognitive function changes in older adults.[1] Cognitive decline in older age can be pathological or part of the normal ageing process,[2] and dementia and depression are two of the psychiatric syndromes and neurocognitive disorders that present associated cognitive decline.[3]

Dementia is a major cause of disability and dependence in older adults.[4] The number of people affected by some type of neurocognitive disorder and/or dementia at global level is estimated to be 35.6 million,[5] a figure that is expected to reach 60 million by 2030.[6] The prevalence of depression in dementia is 32%.[7]

Depression and depressive symptoms are two of the most frequent psychiatric disorders in older adults, with a prevalence ranging from 4.6% to 9.3% for severe depression and from 4.5% to 37.4% for depressive disorders in people aged 75 and over, depending on the type of study conducted, the population studied and the diagnostic tools used.[8] The highest rate of depressive symptoms occurs in those aged 80 and over, in institutionalized individuals and those suffering from some kind of dementia.[9-12]

The relationship between cognition and depression has been subject to numerous studies, which have found that older adults with depressive disorders usually present cognitive complaints, and that those with mild cognitive impairment usually suffer from depressive symptoms.[13-17] Moreover, it should be noted that perception of self-efficacy[18] and the concept of cognitive reserve[19] may act as protective factors against cognitive decline and as mediators of depressive symptoms.[20,21] Likewise, apathy can have a negative impact on the relationship between cognition and depression.[22]

With respect to sociodemographic variables, older age,[1,23] female gender[1,24] and not being married[25-27] are related to lower cognitive status. In addition, loneliness is associated with increased depressive symptoms and lower cognitive performance.[28,29] Li et al.[1] found that lower income and higher economic concerns were related to a lower cognitive status. In terms of education, there is an association between lower educational level, a higher risk of depressive symptoms[30] and lower cognitive performance,[31] and higher educational levels are related to greater cognitive reserve.[19] Finally, poorer self-perceived physical

health, the presence of diseases and activities of daily living (ADL) deficits contribute to depressive symptoms and lower cognition. At the same time, lower cognitive status favours poorer self-perceived physical health.[15, 32]

The EURO-D[33] depression scale has been widely used to detect depressive symptoms and associated variables. A factor analysis of the EURO-D in the original scale generated two factors, Affective Suffering and Motivation, which have been validated by further research.[34-37] Several studies have analysed the variables associated with the two EURO-D factors and found that the female gender is more strongly associated with the Suffering factor,[34,36-38] and lower verbal fluency with the Motivation factor.[36,38] Research has addressed the role of age and cognition, especially in the Motivation factor. The hypothesis of late-onset depression and executive function deficits[39] could explain the higher Motivation factor score in older age and poor cognition.[36] Given this background, it was considered useful to explore the relationship between general cognition and the Suffering and Motivation factors[34] of the EURO-D[33] depression scale.

The analysis of the effect of cognition and other clinical and sociodemographic variables in the EURO-D depression scale and in the factors Suffering and Motivation will allow us to assess their differential contribution to depression. Previous research indicates that a higher score of Motivation factor seems to be related to lower verbal fluency, higher vascular risk and cognitive impairment. We consider it especially relevant to clarify the relevance of cognition, as an independent variable, with respect to other variables of possible confusion (age, gender, education, loneliness or health) in the differences between the factors Suffering and Motivation of the EURO-D depression scale.

Thus, the aims of this study were: 1) to analyse the relationship between cognition and clinical and sociodemographic variables; 2) to explore the relationship between cognition subscales and EURO-D depression scale factors (Suffering and Motivation); and 3) to determine the relevance of cognition with respect to other clinical and sociodemographic variables in the EURO-D factor scores.

2   METHOD

2.1   Design and study population

Data from the Survey of Health, Ageing and Retirement in Europe (SHARE) Wave 6, conducted in 2015, were used. This transnational, multidisciplinary study carried out in 18 countries (Austria, Germany, Sweden, Spain, Italy, France, Denmark, Greece, Switzerland, Belgium, Israel, the Czech Republic, Poland, Luxembourg, Portugal, Slovenia, Estonia and Croatia) collects information on the health, socioeconomic status and social networks of individuals aged over 50 who are not institutionalized.[40,41]

Data were collected through a computer-assisted personal interview (CAPI) that lasted approximately 90 minutes and took place in participants' homes.[40] The study comprised 63,755 subjects out of the 67,214 initially available in SHARE Wave 6, following the exclusion of cases in which information was missing for some items in the EURO-D depression scale.[33]

2.2   Variables and instruments

Sociodemographic data. Age (average and subgroups), gender, marital status (married, widowed, divorced, never married), years of schooling (<8, 8-12, >12), economic difficulties (those making ends meet with great difficulty, with some difficulty, fairly easily, easily).

Data on physical health and diseases. Self-perceived physical health (very good, good, fair, poor), presence of diseases (none, 1, 2, >2), existence of activities of daily living (ADL) deficits (none, 1-2, >2). The diseases included in the variable "presence of diseases" were: heart attack, hypertension, cholesterol, stroke, diabetes, chronic lung disease, cancer, stomach or duodenal ulcer, Parkinson, cataracts, hip fracture or femoral fracture, other fractures, Dementia, other emotional disorders, rheumatoid arthritis, and osteoarthritis/other rheumatism.

In addition, the activities included in the variable "existence of ADL deficits" were: dressing, bathing, eating, getting in or out of bed, using the toilet, preparing a hot meal, shopping for groceries, telephone calls,

taking medications, and managing money. They were assessed by asking if the participants were able to do them by themselves or not

Loneliness scale. The three-item loneliness scale was used (lack of company, isolation from others, feeling of irrelevance), which indicates the frequency with which feelings of loneliness are experienced (almost never = 1, sometimes = 2, almost always = 3), with a total score ranging from 3 to 9, as each item could range from 1 to 3.[42] A higher score indicates a higher presence of loneliness. In a study by Hughes et al.,[42] the scale produced a moderate Cronbach's alpha (0.72), as in the present study (0.75). The 3-item questionnaire was adapted from the Revised UCLA Loneliness Scale (R-UCLA), after exploratory and confirmatory factor analysis. Both the 3-item loneliness scales and the R-UCLA have been validated and are able to be self-administered. We classified subjects with feelings of loneliness when the overall score was >3.

Depressive symptoms. The instrument used was the EURO-D depression scale,[33] which consists of 12 dichotomous items to indicate the presence or absence of the following symptoms over the last month: depressive symptoms, pessimism, a desire for death, guilt, irritability, tearfulness, fatigue, sleep problems, disinterest, loss of appetite, lack of concentration and lack of enjoyment. The cut-off point for depression is ≥ 4. The total score ranges from 0 to 12. Higher scores indicate a higher presence of depressive symptoms. In the EURODEP[35] study, the scale had a moderate Cronbach's alpha (0.61-0.75), as in the present study (0.71). The present study used the factorial solution from a previous study[34] that established the presence of two factors in the EURO-D scale: Suffering (composed of the items depressive symptoms, guilt, sleep problems, irritability, fatigue and tearfulness) and Motivation (composed of the items pessimism, disinterest, loss of appetite, lack of concentration and lack of enjoyment).

General cognition. Specific items in the SHARE project were used to assess the cognitive status of participants based on immediate recall (presenting a list of 10 words that should be repeated immediately; range = 0-10), delayed recall (asking for the list of 10 words presented before; range = 0-10), orientation (asking about the day, month, year and the day of the week; range = 0-4), subtraction (asking simple mathematical operations

to mentally calculate; range = 0-5) and verbal fluency (asking about the maximum number of animals remembered in a given period of time; range = 1-10). A joint scale was created with all items with a total score range of 1 to 39. The higher the score, the higher the cognition.

2.3 Statistical analysis

A descriptive study of the sample was performed using means and standard deviation for the continuous variables and frequencies for the categorical variables. The categorical variables were contrasted with the chi-squared test (χ^2), while the parametric tests of the *t*-test and ANOVA F-test were used for the continuous variables.

The effect size of the difference between two means was assessed using Cohen's *d*, whose values indicate weak (0.2-0.4), moderate (0.5-0.8) or strong (> 0.8) effects.[43] The difference between several means was determined with eta-squared (η^2), whose values indicate weak (0.01-0.05), moderate (0.06-0.13) or strong (> 0.14) effects.[44]

Multiple linear regression analysis was adjusted by introducing all independent variables in a single step: age, gender, marital status, schooling, economic difficulties, loneliness, physical health, diseases, ADL deficits and EURO-D factors (Suffering and Motivation). Variables with a high degree of collinearity and/or a low coefficient of contribution were eliminated. The final model included the following variables: age, schooling, economic difficulties, depression (measured with the EURO-D scale), ADL deficits and physical health. A complementary analysis was carried out with the Suffering and Motivation factors by substituting the global EURO-D score. The coefficient of contribution (CC) of each variable was calculated according to the solution suggested by Guilford & Fruchter:[45] beta coefficient x correlation coefficient (Pearson) with the dependent variable.

The Pearson correlation coefficient was used to assess the correlation between general cognition and the cognitive tests; and the EURO-D depression scale and associated factors (Suffering and Motivation). To assess the differences between the correlation values, Fisher's[46] transformation converted r to z. The

correlation effect sizes were analysed in light of weak (0.20-0.34), moderate (0.35-0.50) and strong (>0.50) values.[47]

To compare the scores of the Motivation (range = 0-5) and Suffering (range = 0-6) factors, the direct scores relating to the clinical and sociodemographic variables were transformed into T scores (10z+50), since the range of the two factors was different.

Finally, several multivariable regression analyses were adjusted, with and without the general cognition, to assess the influence of the variables on the EURO-D depression scale and the Suffering and Motivation factors.

The level of statistical significance for the hypothesis contrasts was 0.05 two sided. Statistical analysis was performed using SPSS v22.0 for Windows (SPSS Inc., Armonk, NY, USA).

3. RESULTS

3.1 Description of the sample

The study sample consisted of 63,755 participants with a mean age of 67.5 ± 9.7 years. The majority were women (56.2%), were married (69.0%), had more than eight years of schooling (78.8%) and had no major economic difficulties (61.3%). The 56.0% did not feel lonely, presented favourable physical health (61.6%), had no ADL deficits (86.4%) and were suffering from one illness or none (51.2%).

With regard to depression, 27.4% of the participants scored above the cut-off point for depression (EURO-D: ≥ 4). The overall mean score for depression was 2.4 ± 2.2. The Suffering factor presented a higher average score than the Motivation factor (1.7 ± 1.5 vs 0.6 ± 0.9; p <0.001).

The mean score of the general cognition was 22.4 ± 6.7. Full data are shown in Table 1.

Table 1

3.2 Variables associated with cognition

The bivariate analysis showed strong associations with effect size ($\eta^2 > 13$) between the poor general cognition with higher age and lower educational level. The higher economic difficulties, poorer self-perceived physical health, the presence of diseases, ADL deficits and depressive symptoms were also associated with poor cognition, with a moderate effect size. The other variables examined, i.e. gender, marital status and diseases, showed a lower association with a weak effect size.

The correlation between general cognition and the Motivation factor was higher than that between general cognition and the Suffering factor, although both were significant. Full results are shown in Supplementary table 1.

3.3 Cognition and variables: multiple linear regression analysis

The variables that presented a higher association with higher general cognition were younger age (β = -0.29), higher educational level (β = 0.26), lesser economic difficulties (β = -0.17) and a lower depression level (β = -0.10). The EURO-D factors had a negative association with general cognition that was more relevant in the Motivation factor (β =-0.20) than in the Suffering factor (β = -0.04). Full data are shown in Table 2.

Table 2

3.4 Correlations between cognition, EURO-D depression scale and factors

Motivation factor had higher correlation with the cognitive tests than Suffering factor and with EURO-D depression scale. The correlation of general cognition was weak in Suffering (r = -0.139) and moderate in Motivation (r = -0.382), although the correlations were always significant.

In view of the transformed Fisher's[46] z, the main differences in the correlations between the Suffering and Motivation factors appeared in the general cognition score, and in the cognitive tests: verbal fluency and immediate recall. Full data are shown in Table 3.

Table 3

3.5 Multivariate regression analysis: EURO-D depression scale, factors and cognition

Three linear regression analyses were adjusted for the EURO-D depression scale and for each factor, i.e. Suffering and Motivation. All independent variables were introduced in a single step, and those that showed a high degree of collinearity and/or a low contribution coefficient were eliminated, thereby resulting in a final model that included cognition, loneliness, physical health, gender, diseases, ADL deficits and age.

In the EURO-D and in both factors, a higher depression level was associated with higher loneliness and poorer self-perceived physical health. In the Suffering factor, diseases (β = 0.127, *p* <0.001) and younger age (β = -0.105, *p* <0.001) also had betas higher than 0.10, associated with higher depression, while in the Motivation factor, ADL deficits (β = 0.126, *p* <0.001) were more relevant.

The main differences in the associations of the independent variables with respect to both EURO-D factors were non-significance of general cognition in the Suffering factor (β = 0.002, *p* = 0.648) and significance in the Motivation factor (β = -0.248, *p* <0.001). With respect to females, the opposite occurred, i.e. it was more significant in the Suffering factor (β = 0.175, *p* <0.001) than in the Motivation factor (β = 0.015, *p* <0.001). In terms of the relevance of the variables in the EURO-D, general cognition occupied fourth position (β = -0.110, *p* <0.001) in relation to the overall score. However, it occupied last position, i.e. it was non-significant, in the Suffering factor and first position in the Motivation factor.

The same regression analysis was repeated without introducing the variable general cognition. There were few changes in the Suffering factor: age continued to have a negative effect (β = -0.101, *p* <0.001) and educational level showed a slightly positive effect (β = 0.020, *p* <0.001). In the Motivation factor, loneliness (β = 0.247, *p* <0.001 vs β = 0.274, *p* <0.001; + 0.027) and poor self-perceived physical health (β = 0.149, *p* <0.001 vs β = 0.178, *p* <0.001; -+0.029) increased, gender significance decreased (β = 0.015, *p* <0.001 vs. β = 0.001, *p* 0.784; -0.014), ADL deficits increased (β = 0.126, *p* <0.001 vs β = 0.160, *p* <0.001; +0.034), older age changed sign (β = -0.033, *p* <0.001 vs β = 0.029, *p* <0.001; +0.062), and the negative effect of lower educational level increased (β = -0.036, *p* <0.001 vs β = -0.108, *p* <0.001; + 0.075). The complete data are shown in Table 4.

Table 4

Data regarding age are concordant with those of the bivariate analysis (Supplementary Table 2). Higher age was associated with higher scores in the Motivation factor (t = 44.7, *p* <0.001, d = 0.47) than in the Suffering factor (t = 14.1, *p* <0.001, d = 0.17).

4. DISCUSSION

4.1 Relationship between cognition and clinical and sociodemographic variables

The first aim of the study was to explore the relationship between clinical and sociodemographic variables and the general cognition of the participants. The analysis showed that the variables most associated with poor cognition were older age, lower educational level, higher economic difficulties and higher depression level. The EURO-D factors Suffering and Motivation,[34] were also associated with poorer cognition, to a greater extent in the Motivation factor than in the Suffering factor.

These results corroborate previous studies that indicate that older age was associated with poorer cognitive performance[1,23], fact that some authors explain by the lower physical activity, exercise and cognitive training that is common in older adults.[48, 49] In addition, lower educational levels and the consequent poorer cognitive reserve[19] would be associated with poorer cognition[31] and faster cognitive decline.[48] Similarly, economic difficulties would be related to a higher frequency of depressive symptoms and poorer cognitive performance due to a cumulative effect whereby the deficiencies over the years due to economic difficulties cause poorer access to health services. [1,51] The stressors inherent to economic concerns would also affect the appearance of depressive symptomatology and affect the neural circuits.[52] It seems, therefore, that education and economic aspects act as mediators in the influence of older age on cognition, given that the educational level is closely related to occupational complexity and the economic status in adulthood.[53]

4.2. Relationship between cognition and EURO-D factors

The second aim of the study was to analyse the relationship between cognition and the EURO-D and its factors, i.e. Suffering and Motivation. The analysis showed that the correlations between the cognitive tests and the EURO-D factors were always negative and higher for the Motivation factor, with significant differences between factors in each cognitive test.

The main differential aspects of general cognition between the Suffering and Motivation factors were general cognition, verbal fluency and immediate recall. These subscales, which measure mental flexibility and the capacity to consolidate and recover memories, were the most strongly influenced by depressive symptoms, both in the overall EURO-D score and in the Suffering and Motivation factors.[14,34,54]

Other authors who have used the same EURO-D depression scale have found verbal fluency performance to be more strongly associated with motivational symptoms of depression than with affective suffering symptoms.[36-38,55] In our study, verbal fluency also presented the highest correlation with the Motivation factor, although the correlations with this factor were higher in all cognitive subscales.

4.3 Variables associated with the EURO-D and Suffering and Motivation factors

The third objective of this study was to determine the relevance of cognition with respect to the other clinical and sociodemographic variables in the EURO-D and the Suffering and Motivation factor scores.

Loneliness and health problems were common variables in the EURO-D and Suffering and Motivation factors. The association between higher loneliness and higher depressive scores in both factors might be due to the lack of social interaction[28] and social support[29] that people with depression generally experience. With regard to health, in terms of both self-perceived physical condition and ADL deficits and the presence of diseases, our results are consistent with those usually reported in the literature,[56-58] thus confirming that the poorest perception of health and/or diseases or ADL deficits were associated with a higher presence of depressive symptoms.

The main differences revealed in the analysis were that general cognition was non-significant in the Suffering factor, but significant in the Motivation factor, and gender was more relevant in the Suffering

factor. Our results corroborate the findings of previous studies, i.e. that poorer cognition was associated with higher depression levels.[13-17] The most relevant of our findings was that the association between a poor cognition and a greater depression only occurred in the motivation factor. One possible explanation is that the Motivation factor includes some specific cognitive items such as disinterest, lack of concentration or lack of enjoyment, while the items of the Suffering factor are not specifically cognitive. Some authors have hypothesized that vascular depression could explain this stronger association between the motivational factor and poor cognition [59], while others have suggested that high scores on motivational symptoms would be more present in subjects with mild cognitive impairment [60] or even be a prodrome of dementia.[61]

A second difference was that women were more relevant in the Suffering factor, according to several studies,[34,36-38] and usually present higher percentages of widowhood, loneliness and social isolation.[35,36,58,62]

A key topic addressed by several authors is the influence of age and cognition on Motivation factor scores.[36,38] They consider that Motivation factor scores could be related to the depression-executive dysfunction hypothesis, with the presence of motivation-related symptoms caused by the deterioration of executive function in ageing,[39] since older age may lead to a reduction in cognitive function, as well as less activity and motivation.[37] In our study, eliminating cognition from the regression analysis, in the Motivation factor was associated with an increase in ADL deficits and higher age, and therefore the hypothesis that executive deficits are more frequent in age-related depression could be related to higher scores in the Motivation factor. However, while the older age was related to a higher Motivation factor,[38] the younger age was related to a higher Suffering factor.

It is possible that the differences between the Suffering and Motivation factors are due to a multiplicity of personal and cultural variables (age, education, economic situation, employment, physical exercise, cognition, health, etc.). In a previous study,[34] a clear differentiation between European countries was observed. In Central and Northern European countries there was a predominance of the Suffering factor, while in Southern European countries there was a predominance of the Motivation factor.

4.4   Clinical implications

Our results corroborate the association between depression and cognitive decline.[13-17] The presence of depression favours lower cognitive performance, in the same way that cognitive performance influences and conditions the possible presence of depressive symptomatology. Nevertheless, different sociodemographic variables would mediate and modify the type and direction of these associations. It is therefore necessary to assess the presence of both depression and cognitive impairment at the time of diagnosis to establish appropriate therapeutic criteria.

In light of the results of our study and previous research, it would be convenient to specifically assess the Motivation factor items because of their remarkable association with lower cognition and possible cognitive deterioration.

4.5   Limitations and future research

An important limitation of our study has been the absence of a clinical examination of the participants regarding depression, as well as not being able to use other psychometric instruments on depression to compare the results.

Given the importance of education in cognition, it would be advisable to carry out further research on the education system in each of the countries of origin of the SHARE participants with a view to assessing this specific aspect. Moreover, given the impact that health has on depression, it would be useful to identify the diseases and ADL deficits that condition self-perception of health status and the associated depression.

Although this is a comprehensive and cross-cutting analysis, a longitudinal study that reflects the differences between countries and/or European regions would be useful.

5. CONCLUSIONS

This analysis showed an association mainly between lower cognitive status and higher age and lower educational levels. Greater economic difficulties and the presence of depressive symptoms were also related to lower cognitive performance.

The scores of the depression scale (EURO-D) were associated with greater loneliness, poorer self-perceived health, female gender and lower cognition.

Regarding the Motivation and Suffering factors, lower cognition was associated with higher scores only in the Motivation factor (EURO-D), while the female gender was associated with higher scores in the Suffering factor (EURO-D). Age presented a different relationship with depression depending on the factor, with lower age being relevant in the Suffering factor and higher age in the Motivation factor.

6. ACKNOWLEDGEMENTS

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TABLE 1   Clinical and sociodemographic data

Characteristic	Category	Value	Characteristic	Category	Value
Age	mean (SD)	67.5 (9.7)	**Diseases**	None	23.0
	Range	50-105		1	28.2
				2	21.3
Age groups	<60 years	24.0		>2	27.4
	61-70 years	36.3			
	71-80 years	26.1	**ADL deficits**	None	86.4
	≥ 80 years	13.6		1-2	9.1
				> 2	4.5
Gender	Male	43.8			
	Female	56.2	**EURO-D**	mean (SD)	2.4 (2.2)
				Range	0-12
Marital status	Married	69.0		≥ 4 points	27.4
	Widowed	15.5	Suffering f.	mean (SD)	1.7 (1.5)
	Divorced	9.9		Range	0-6
	Never married	5.6	Motivation f.	mean (SD)	0.6 (0.9)
				Range	0-5
Education (years)	> 12	33.5			
	8-12	45.3	**COGNITION**	mean (SD)	22.4 (6.7)
	< 8	21.2		Range	1-39
			Immediate recall	mean (SD)	5.3 (1.7)
Economic diffic.	Great difficulty	12.3		Range	0-10
	Some difficulty	26.3	Delayed recall	mean (SD)	3.9 (2.1)
	Fairly easily	26.9		Range	0-10
	Easily	34.4	Orientation	mean (SD)	3.8 (0.4)
				Range	0-4
Loneliness	Yes	44.0	Subtraction	mean (SD)	4.1 (1.4)
	No	56.0		Range	0-5
			Fluency	mean (SD)	5.2 (2.8)
Self-perceived health	Very good	25.2		Range	1-10
	Good	36.4			
	Fair	28.6			
	Poor	9.8			

Data columns are % unless otherwise stated. R, Range; EURO-D = Depression; ADL, Activities of daily living

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TABLE 2   General cognition and variables. Multivariate regression analysis

Characteristics	$r^2 = 0.356$		B	(SE)	β	t	p	r	CC (%)
Age	- =	less	-0.20	(0.00)	-0.29	-84.5	**< 0.001**	-0.40	12.0
Education (years)	+ =	more	0.41	(0.00)	0.26	77.2	**< 0.001**	0.42	11.4
Economic diffic.	- =	less	-1.10	(0.02)	-0.17	-48.9	**< 0.001**	-0.28	4.8
EURO-D	- =	less	-0.30	(0.01)	-0.10	-27.2	**< 0.001**	-0.27	2.8
Deficits ADL	- =	less	-0.59	(0.02)	-0.09	-26.3	**< 0.001**	-0.26	2.4
Self-perceived health	+ =	better	0.49	(0.02)	0.07	18.1	**< 0.001**	0.32	2.2
F (df), *p*			5632.6 (6 - 61,105)				**< 0.001**		
Collinearity: Tol. / VIF.			0.71-0.86 / 1.15-1.40						

Replacing the EURO-D by the factors

	$r^2 = 0.380$								
Suffering factor	- =	less	-0.19	(0.01)	-0.04	-12.9	**< 0.001**	-0.13	0.6
Motivation factor	- =	less	-1.41	(0.02)	-0.20	-56.0	**< 0.001**	-0.37	7.7

F, ANOVA; r^2, Coefficient of determination; B, Unstandardized coefficient; SE, Standard error; β, Standardized beta coefficient ≥ 0.04; *t*, Student's *t*-test; *r,* Pearson correlation; CC, coefficient of contribution *(%)*, [(β. *r)* x 100)]; Tol, Tolerance; VIF, Variance inflation factor. *p-values* <0.05 are shown in bold

Dependent variable, General cognition. EURO-D, Depression scale; ADL, Activities of daily living.

TABLE 3 Correlations between cognitive tests, EURO-D and factors

	EURO-D		1. Suffering		2. Motivation	
	r	*p*	*r*	*p*	*r*	*p*
Cognition subscales						
Immediate recall	-0.211	**< 0.001**	-0.097	**< 0.001**	-0.300	**< 0.001**
Delayed recall	-0.196	**< 0.001**	-0.093	**< 0.001**	-0.277	**< 0.001**
Orientation	-0.179	**< 0.001**	-0.096	**< 0.001**	-0.234	**< 0.001**
Subtraction	-0.248	**< 0.001**	-0.150	**< 0.001**	-0.301	**< 0.001**
Fluency	-0.219	**< 0.001**	-0.104	**< 0.001**	-0.311	**< 0.001**
General cognition	-0.279	**< 0.001**	-0.139	**< 0.001**	-0.382	**< 0.001**

r = Pearson correlation; *p-values* <0.05 are shown in bold. z = Fisher transformation r to z (Fisher, 1915). Effect size of correlations: weak, 0.20-0.34; moderate, 0.35-0.50; strong, >0.50 (Guyatt et al., 1999). EURO-D = Depression scale; Factor 1 (*Suffering*) and Factor 2 (*Motivation*).

TABLE 4 EURO-D, Suffering and Motivation factors, and variables. Multivariate regression analysis

Characteristics		EURO-D $r^2 = 0.364$			1.Suffering $r^2 = 0.280$			2.Motivation $r^2 = 0.277$			Differences 1-2
		β	t	p	β	t	p	β	t	p	β
With Cognition (- = lower)		-0.110	-29.9	**< 0.001**	0.002	0.4	0.648	-0.248	-63.2	**< 0.001**	+0.250
Loneliness	(+ = more)	0.321	94.8	**< 0.001**	0.274	76.0	**< 0.001**	0.247	68.5	**< 0.001**	-0.027
Self-R. Health	(+ = poorer)	0.245	62.8	**< 0.001**	0.243	58.6	**< 0.001**	0.149	35.7	**< 0.001**	-0.094
Gender	(+ = female)	0.131	40.9	**< 0.001**	0.175	51.2	**< 0.001**	0.015	4.2	**< 0.001**	-0.160
Diseases	(+ = more)	0.107	28.1	**< 0.001**	0.127	31.5	**< 0.001**	0.028	6.8	**< 0.001**	-0.099
Deficits ADL	(+ = more)	0.104	29.6	**< 0.001**	0.054	14.4	**< 0.001**	0.126	33.7	**< 0.001**	+0.072
Age	(- = younger)	-0.091	-25.1	**< 0.001**	-0.105	-27.3	**< 0.001**	-0.033	-8.6	**< 0.001**	+0.072
F (df), p		5145.3 (7-62831)		**< 0.001**	3494.7 (7-62831)		**< 0.001**	3439.1 (7- 62831)		**< 0.001**	
Collinearity: Tol. / VIF.		0.66-0.98 / 1.01-1.50									

Without Cognition		EURO-D $r^2 = 0.359$			1.Suffering $r^2 = 0.282$			2. Motivation $r^2 = 0.246$			Differences 1-2
		β	t	p	β	t	p	β	t	p	β
Loneliness	(+ = more)	0.334	99.2	**< 0.001**	0.275	77.1	**< 0.001**	0.274	75.1	**< 0.001**	-0.001
Self-R. Health	(+ = poorer)	0.261	67.0	**< 0.001**	0.248	60.1	**< 0.001**	0.178	42.1	**< 0.001**	-0.070
Gender	(+ = female)	0.125	38.9	**< 0.001**	0.175	51.5	**< 0.001**	0.001	0.2	0.784	-0.174
Diseases	(+ = more)	0.104	27.4	**< 0.001**	0.128	31.7	**< 0.001**	0.022	5.3	**< 0.001**	-0.106
Deficits ADL	(+ = more)	0.118	33.7	**< 0.001**	0.052	14.1	**< 0.001**	0.160	42.1	**< 0.001**	+0.108
Age	(- = younger)	-0.060	-17.2	**< 0.001**	-0.101	-10.1	**< 0.001**	0.029	7.6	**< 0.001**	+0.130
Schooling	(- = less)	-0.034	-10.2	**< 0.001**	0.020	5.7	**< 0.001**	-0.108	-29.8	**< 0.001**	+0.128
F (df), p		5044.3 (7-63030)		**< 0.001**	3529.8 (7-63030)		**< 0.001**	2945.2 (7- 63030)		**< 0.001**	
Collinearity: Tol. / VIF.		0.67-0.98 / 1.01-1.48									

F, ANOVA; *r^2*, Coefficient of determination; β, Standardized coefficient; SE, Standard error; *t*, Student's t test; Tol, Tolerance; VIF, Variance Inflation Factor. *p-values* <0.05 are shown in bold. EURO-D, Depression scale; ADL, Activities of daily living. Cognition, General cognition

SUPPLEMENTARY TABLE 1   General cognition scores in the variables

Characteristic	Category	Mean (SD)	Characteristic	Category	Mean (SD)
Age	<60 years	25.3 (5.7)	**Loneliness**	Yes	21.2 (6.9)
	61-70 years	23.8 (5.9) [a]		No	23.5 (6.3)
	71-80 years	21.0 (6.3) [b, d]		t *(p) d*	**(< 0.001)** 0.34
	≥ 80 years	16.6 (6.6) [c, e, f]			
	F *(p)* η^2	**(< 0.001)** 0.17	**Self-p. health**	Very good	25.3 (5.7)
				Good	23.0 (6.2) [a]
Gender	Male	22.3 (6.3)		Fair	20.7 (6.7) [b, d]
	Female	22.5 (7.0)		Poor	18.1 (7.2) [c, e, f]
	t *(p) d*	**(< 0.001)** 0.03		F *(p)* η^2	**(< 0.001)** 0.10
Marital status	Married	22.9 (6.4)	**Diseases**	None	24.4 (6.1)
	Widowed	19.3 (7.2) [a]		1	23.0 (6.5) [a]
	Divorced	24.2 (6.2) [b, d]		2	22.1 (6.6) [b, d]
	Never married	22.8 (6.9) [e, f]		> 2	20.5 (6.9) [c, e, f]
	F *(p)* η^2	**(< 0.001)** 0.04		F *(p)* η^2	**(< 0.001)** 0.04
Education	> 12 years	25.6 (5.6)	**ADL** deficits	None	23.1 (6.3)
	8 – 12 years	22.2 (6.0) [a]		1-2	19.3 (7.0) [a]
	< 8 years	17.9 (6.8) [b, d]		> 2	15.1 (7.5) [b, d]
	F *(p)* η^2	**(< 0.001)** 0.16		F *(p)* η^2	**(< 0.001)** 0.08
Economic diffic.	Great difficulty	18.9 (6.7)	**EURO-D**	< 4 points	23.4 (6.2)
	Some difficulty	21.2 (6.4) [a]		≥ 4 points	20.0 (7.3)
	Fairly easily	22.9 (6.4) [b, d]		t *(p) d*	**(< 0.001)** 0.50
	Easily	24.5 (6.1) [c, e, f]	Suffering f.	r (p)	-0.13 (**<0.001**)
	F *(p)* η^2	**(< 0.001)** 0.07	Motivation f.	r (p)	-0.38 (**<0.001**)

F = ANOVA; Significant with Bonferroni post-hoc contrasts: [a]1-2, [b]1-3, [c]1-4, [d]2-3, [e]2-4, [f]3-4; *t* = Student's *t*-test; r, Pearson correlation; Eta-squared (η^2) = weak (< 0.05), moderate (0.06 - 0.13), strong (> 0.13); Cohen's *d* (*d*) = weak (< 0.50), moderate (0.50-0.80), strong (> 0.80). *p-values* <0.05 are shown in bold
EURO-D = Depression scale; ADL, Activities of daily living.

SUPPLEMENTARY TABLE 2. Suffering and Motivation factors of the EURO-D scale and variables

	F. Suffering	F. Motivation	Differences in T scores		
	Mean (SD)	Mean (SD)	t	p	d
Age (years)					
1. < 80	49.7 (10.0)	49.2 (9.8)	-9.8	<0.001	0.05
4. ≥ 80:	51.4 (9.6)	54.5 (12.8)	22.1	<0.001	0.27
t (p) d	14.1 (<0.001) 0.17	44.7 (<0.001) **0.47**			
Cognition (scores)					
1. 28-39	48.7 (9.5)	46.6 (6.3)	-27.6	<0.001	0.26
2. 24-27	49.2 (9.6) [a]	47.7 (7.3) [a]	-17.5	<0.001	0.17
3. 19-23	49.7 (9.9) [b, d]	49.4 (8.8) [b, d]	-2.9	0.004	0.03
4. 0.18	52.0 (10.3) [c, e, f]	55.3 (12.8) [c, e, f]	34.8	<0.001	0.28
F (p) n^2	349.9 (<0.001) 0.01	2825.1 (<0.001) **0.11**			
Schooling (years)					
1. > 12	49.1 (9.6)	47.8 (7.8)	-17.8	<0.001	0.14
2. 8-12	50.1 (10.0) [a]	49.8 (9.6) [a]	-5.0	<0.001	0.03
3. <8	51.0 (10.3) [b, d]	53.6 (12.4) [b, d]	25.6	<0.001	0.22
F (p) n^2	157.0 (<0.001) 0.00	1454.6 (<0.001), 0.04			
Loneliness (scores)					
1. No	47.2 (8.7)	47.7 (7.6)	10.2	<0.001	0.06
2. Yes	53.5 (10.3)	52.8 (11.7)	-9.4	<0.001	0.06
t (p) d	82.7 (<0.001) **0.66**	65.3 (<0.001) **0.51**			
Self-p. health (groups)					
1. Very good	45.7 (8.0)	46.6 (6.5)	13.0	<0.001	0.12
2. Good	48.4 (9.1) [a]	48.2 (7.9) [a]	-2.7	0.006	0.02
3. Fair	52.8 (10.0) [b, d]	51.9 (10.7) [b, d]	-10.0	<0.001	0.08
4. Poor	58.5 (9.7) [c, e, f]	59.4 (14.0) [c, e, f]	5.4	<0.001	0.07
F (p) n^2	3692.2 (<0.001) **0.14**	3385.1 (<0.001) **0.13**			
Gender					
1. Male	47.4 (8.7)	49.4 (9.3)	32.6	<0.001	0.22
2. Female	51.9 (10.4)	50.4 (10.4)	-25.2	<0.001	0.14
t (p) d	57.9 (<0.001) **0.47**	12.5 (<0.001) 0.10			
ADL (deficits)					
1. None	49.0 (9.6)	48.8 (8.7)	-4.1	<0.001	0.02
2. 1-2	55.2 (10.0) [a]	55.0 (10.0) [a]	-1.3	0.178	0.02
3. ≥ 2	57.8 (9.8) [b, d]	61.9 (14.7) [b, d]	14.7	<0.001	0.32
F (p) n^2	2076.4 (<0.001) **0.06**	3484.3 (<0.001) **0.09**			
Diseases					
1. None	46.3 (8.4)	47.3 (7.2)	13.3	<0.001	0.12
2. 1	48.8 (9.4) [a]	48.9 (8.9) [a]	2.0	0.041	0.01
3. 2	50.4 (9.8) [b, d]	50.1 (9.9) [b, d]	-2.8	0.005	0.03
4. > 2	53.9 (1.6) [c, e, f]	53.1 (12.0) [c, e, f]	-8.8	<0.001	0.07
F (p) n^2	1835.3 (<0.001) **0.08**	1038.8 (<0.001) 0.04			
Economic diffic.					
1. Easily	48.2 (9.1)	47.5 (7.4)	-9.4	<0.001	0.08
2. Fairly easily	49.1 (9.5) [a]	48.9 (8.7) [a]	-2.2	0.024	0.02
3. Some difficulty	51.0 (10.3) [b, d]	51.0 (10.4) [b, d]	0.6	0.540	0.00
4. Great difficulty	54.1 (10.9) [c, e, f]	55.6 (13.3) [c, e, f]	10.2	<0.001	0.12
F (p) n^2	779.6 (<0.001) 0.03	1476.2 (<0.001) **0.06**			

F = ANOVA; Bonferroni post-hoc contrasts: [a]1-2, [b]1-3, [c]1-4, [d]2-3, [e]2-4, [f]3-4; Eta-squared (η^2) = weak (< 0.05), medium (0.06 - 0.13), strong (> 0.13); *t* = Student's *t*-test; Cohen's *d* (*d*) = weak (< 0.5), medium (0.5-0.8), strong (> 0.8). Effect size medium and strong in bold. Differences in T scores: negative sign indicates higher scores in Suffering.