Effects of Hospitalisation on Cognitive Function, Activities of Daily Living Capacity and Behaviour in Alzheimer's Disease Patients: a Longitudinal Study

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ABSTRACT

Alzheimer's disease patients need to be hospitalised due to the disease itself or due to associated diseases or life events. The aim of the present study is to ascertain whether there are significant differences between cognitive functions of hospitalised and not hospitalised Alzheimer's patients and correlations between the characteristics of hospitalisation (frequency, duration and the reasons of hospitalisation) and the cognitive functions. 150 patients who were participants in the ELSA study (a longitudinal study on Alzheimer's disease) were followed-up between 1996 and 2001. MMSE (Mini Mental Status Exam) assessing the level of cognitive functions (attention, verbal recall, calculation, language, praxis and orientation) was determined every 6 months. Each patient was followed regarding hospitalisation parameters: number of hospitalisations,period of each hospitalisation (short time hospitalisation < 7 days, long time hospitalisation > 7 days) and reasons for hospitalisation (infections, falls, behaviour problems, malnutrition). Statistical analyses were performed for all factors regarding hospitalisation. The predominance of hospitalised patients in ELSA cohort shows the importance of hospitalisation in the evolution of AD. The comparison between the values of cognitive parameter shows significant differences and correlations between hospitalised populations having different hospitalisation parameters (number, duration, reasons) and nonhospitalised patients, or between different hospitalised populations.

Keywords: Alzheimer, hospitalization, MMSE, ADL, MNA, Cohen

Introduction

Alzheimer's disease (AD) is a form of dementia which appears in the elderly and has a mean course of 8 years ranging from 2 years for the severe forms to 20 years for the slowly progressive forms. The natural course is associated with a number of common complications such as weight loss, enhanced risk of falls and accidents, infections, delusional episodes, hallucinations and sleep disorders, which represent the main burden of the disease both for the patient and family members[1-6].

During the course of the disease, many Alzheimer's patients need to be hospitalised due to the disease itself or due to associated diseases or life events. Several studies have been published in the past few years which report on long-term hospitalisation and nursing home care in Alzheimer's patients[7-17]. However, the frequency, duration and reasons for hospitalisation in Alzheimer's patients have not been previously published.

The aim of the present study is to ascertain whether there are any significant differences between hospitalised and not hospitalised Alzheimer's patients and if there are

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correlations between the characteristics of hospitalisation (frequency, duration and reasons for hospitalisation) and the geriatric and neuropsychological determinations of cognitive function, ADL capacity and behaviour in Alzheimer's patients.

Patients and Methods

We studied 150 patients who were participants in the ELSA study: a longitudinal study on the natural history of AD. They were recruited from the Department of Internal Medicine and Clinical Gerontology, Acute Unit for Alzheimer's Patients, Toulouse, France, and met the NINCDS-ADRDA criteria for diagnosing AD[3,18-22].

A comprehensive geriatric assessment and a neuropsychological assessment were conducted at entry to the ELSA cohort, corresponding to diagnosis data and ELSA 1 (0 months) determinations, and was completed every 6 months, between 1996 and 2001.

The comprehensive geriatric and neuropsychological assessment consists of the following determinations:

- MMSE (Mini Mental Status Exam) to asses the level of cognitive functions (attention, verbal recall, calculation, language, praxis and orientation). The maximum score is 30 points. Scores below 24 points suggest disturbances of cognition.
- MNA (Mini Nutritional Assessment) to asses nutritional status (anthropometry, dietary, global and subjective assessments). The MNA is based on a point system with a maximum score of 30, > 24 points – at no risk of malnutrition, 17 to 25.5 points – at a risk of malnutrition and < 17 points – malnourished.
- ADL (Activities of Daily Living) to asses basic activities of daily living (personal hygiene, toileting, locomotion, continence, dressing, feeding). The maximum score is 6 points and represents total autonomy.
- Cohen to asses behavioural problems (scores from 1 to 70, each point indicating a behavioural problem)

Hospitalisation data

Each patient included in ELSA cohort was followed regarding hospitalisation in any hospital during the study. The following criteria were analyzed:

- number of hospitalisations
- period of each hospitalisation (short time hospitalisation < 7 days, long time hospitalisation > 7 days)
- reasons for hospitalisation:
  1. infections
  2. falls
  3. behaviour problems
  4. malnutrition
  5. other reasons including: social problems, rheumato-orthopedic problems, general status alterations etc.

Statistical methods:

Statistical analyses[23] were performed for all factors regarding hospitalisation.

For numeric variables the mean and the standard deviation were calculated. Chi- square test and two tailed Student's t-test for Equality of Means were used for numeric variables. Variables are statistically significant, revealing if there is a significant difference between two populations.

To compare numeric and categorial variables Levene's Test for Equality of Variances was used to find a correlation.

To find a correlation between cumulative numeric variables and numeric variables: Pearson's test and Spearman Correlation were used.

The level of significance was set at alpha level of $p < 0.05$ for all comparisons.

Results

The mean age of patients was 81 years and 33 % of the investigated population were men.

The number of ELSA determinations for each patient is shown in Table 1.

Data regarding hospitalisations:

100 patients were hospitalised during the ELSA study and 50 patients had no hospitalisation, so the ratio of hospitalised AD patients is 2:1. The comparison of MMSE, MNA, ADL and COHEN mean scores for patients with and without hospitalisation is shown in Table 2.

The data regarding hospitalisation number and duration for the studied period (1996-2001 ELSA cohort) are shown in Table 3. and in Figure 1.

The repartition of hospitalisations for each year of ELSA study (1996-2001 ELSA cohort) is shown in Table 4. and in Figure 2.

The number and duration of hospitalisation correlations with MMSE, MNA, ADL and Cohen are statistically analyzed using Spearman test. The results are shown in Table 9. and Table 10.

The comparison and correlation of MMSE, MNA, ADL and Cohen for short and long hospitalisation periods are shown in Tables 11-14 and in Figures 7-10 for every ELSA year.

The effect of hospitalisation reasons on the variation of MMSE, MNA, ADL and Cohen for each ELSA determination is shown in tables 15-18 and in Figures 11-14.

The statistical analyses of the effect of each frequent hospitalisation reason on MMSE, MNA, ADL and Cohen are shown in Tables 19-22.

Table 1.

ELSA No	1	2	3	4	5	6	7	8	9	10	11
Month	0	6	12	18	24	30	36	42	48	54	60
Patients	8	3	7	23	22	25	10	8	18	20	6

Table 2.

Comparison of MMSE, MNA, ADL and COHEN scores for patients with and without hospitalisation. *N = number of AD patients*

	MMSE (mean)	MNA (mean)	ADL (mean)	COHEN (mean)
hospitalised (N = 100)	9.12	21.90	3.22	24.97
no hospitalised (N = 50)	11.5	23.53	4.06	24.31
p (t- test)	0.068	0.04	0.058	0.07

Table 3.

Number and duration of hospitalisations

No. hospitalisations / patient	No. short time hospitalisations	No. long time hospitalisations	Hospitalisations during ELSA study	no. of patients
1	16	24	40	40
2	22	30	52	26
3	15	24	39	13
4	26	22	48	12
5	14	16	30	6
6	4	2	6	1
7	7	7	14	2
total	104	125	229	100

Figure 1.

Number and duration of hospitalisations

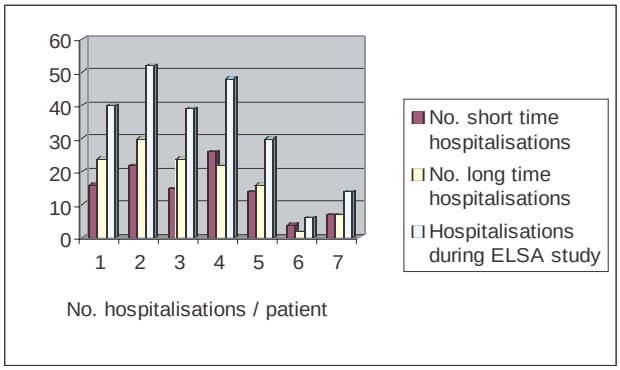

Table 4.

Number of hospitalisations for each year of ELSA study

year	No. short time hospitalisation	No. long time hospitalisation	No. hospitalisation
1996	16	26	42
1997	10	14	24
1998	19	23	42
1999	18	32	50
2000	30	22	52
2001	11	8	19
total	104	125	229

Figure 2.

Number of hospitalisations for each year of ELSA study

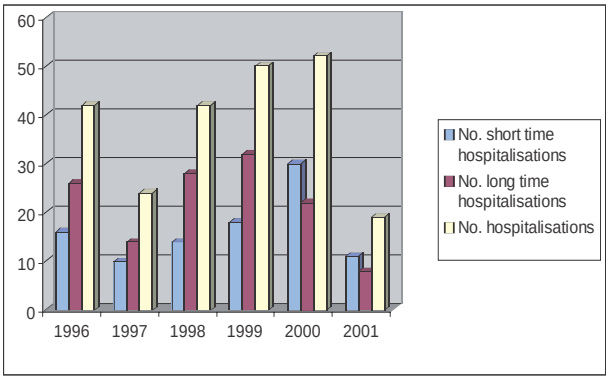

Table 5.

MMSE comparison and correlation for each ELSA determination

	No. ELSA	MMSE hospitalised			MMSE nonhospitalised			MMSE mean	p (Levene's Test)	p (t-test)
		mean	SD	N	mean	SD	N			
1	ELSA 1 (0 months)	14.96	5.4	100	16.19	7.08	50	15.575	**0.024**	0.241
2	ELSA 2 (6 months)	14.2	5.8	85	15.16	7.85	48	14.68	**0.007**	0.411
3	ELSA 3 (12 months)	12.02	6.46	85	14.76	8.02	46	13.39	0.093	**0.036**
4	ELSA 4 (18 months)	10.72	7.08	77	13.69	8.79	46	12.205	0.095	0.056
5	ELSA 5 (24 months)	8.93	6.71	77	12.61	7.84	31	10.77	0.532	**0.026**
6	ELSA 6 (30 months)	7.45	6.38	61	11.61	7.41	21	9.53	0.332	**0.016**
7	ELSA 7 (36 months)	7.4	5.25	45	9.86	7.2	22	8.63	ns	ns
8	ELSA 8 (42 months)	6.2	5.3	29	6.48	7.6	11	6.34	ns	ns
9	ELSA 9 (48 months)	6.1	4.28	28	7.58	5.9	13	6.84	ns	ns
10	ELSA 10 (54 months)	6	5.4	18	7.1	4.2	8	6.55	ns	ns
11	ELSA 11 (60 months)	6.33	3.8	6	-		0	6.33	ns	ns
	Mean	9.119091			11.504					

Figure 3.

MMSE of hospitalised and nonhospitalised AD patients for each ELSA determination

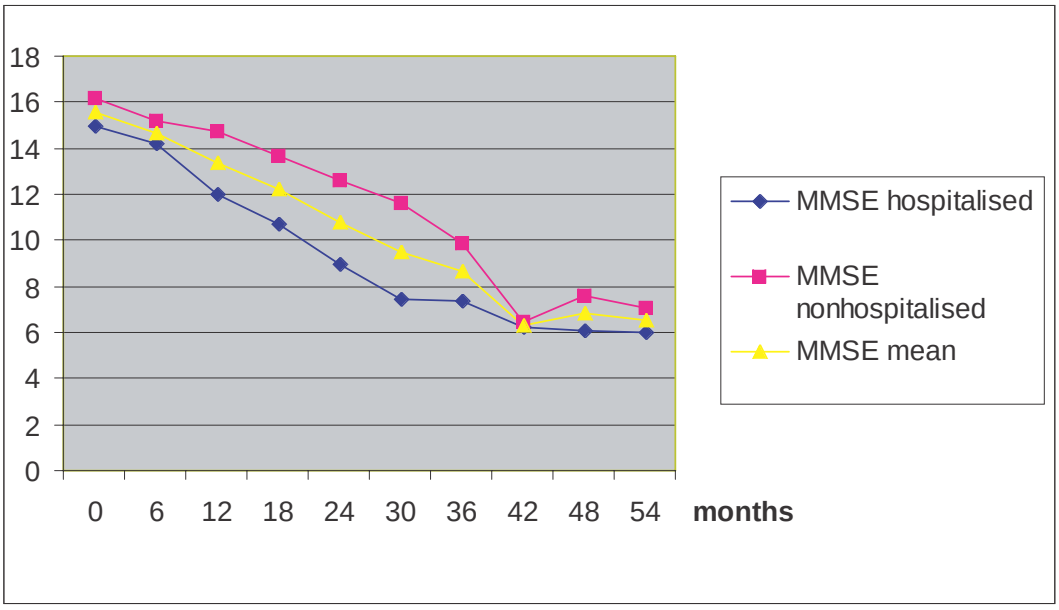

Table 6.

MNA comparison and correlation for each ELSA determination

	No. ELSA	MNA hospitalised			MNA nonhospitalised			MNA mean	p (Levene's Test)	p (t-test)
		mean	SD	N	mean	SD	N			
1	ELSA 1 (0 months)	22.35	7.99	100	25.54	2.51	50	23.945	**0.001**	**0.006**
2	ELSA 2 (6 months)	23.22	5.11	85	24.75	2.88	48	23.985	0.062	0.054
3	ELSA 3 (12 months)	23.58	3.31	85	24.81	2.67	46	24.195	0.401	**0.024**
4	ELSA 4 (18 months)	23.32	3.74	77	24.64	2.4	46	23.98	**0.009**	**0.034**
5	ELSA 5 (24 months)	22.52	5.14	77	23.19	4.18	31	22.855	0.227	0.542
6	ELSA 6 (30 months)	22.09	4.54	61	23.61	3.68	21	22.85	0.096	0.555
7	ELSA 7 (36 months)	21.19	3.5	45	21.47	2.6	22	21.33	ns	ns
8	ELSA 8 (42 months)	20.7	5.61	29	21.5	2.33	11	21.1	ns	ns
9	ELSA 9 (48 months)	21	2.3	28	23	4.21	13	22	ns	ns
10	ELSA 10 (54 months)	19.8	3.6	18	22.8	4.8	8	21.3	ns	ns
11	ELSA 11 (60 months)	21.1	1.9	6	-		0	21.1	ns	ns
	Mean	21.89727			23.531					

Figure 4.

MNA of hospitalised and nonhospitalised AD patients for each ELSA determination

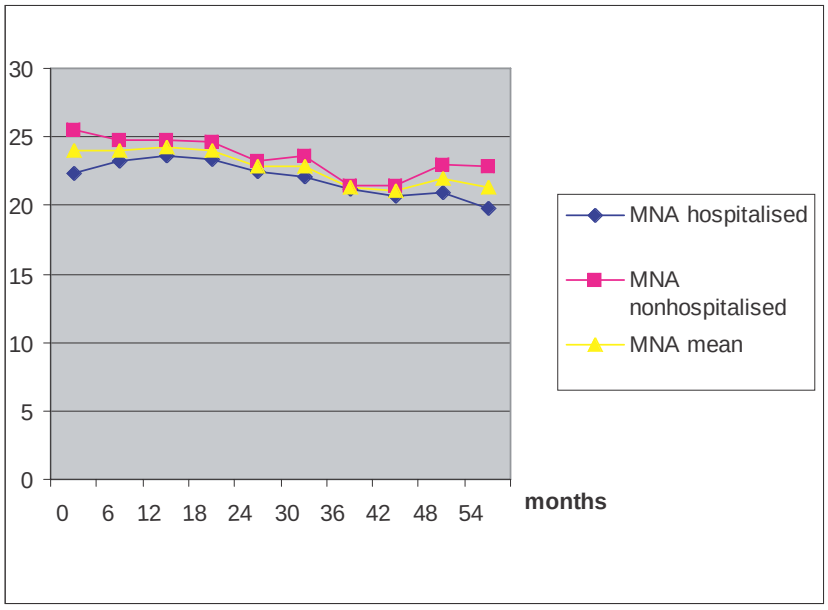

Table 7.

ADL comparison and correlation for each ELSA determination. *ns = statistically not significant*

	No. ELSA	ADL hospitalised			ADL nonhospitalised			ADL mean	p (Levene's Test)	p (t-test)
		mean	SD	N	mean	SD	N			
1	ELSA 1 (0 months)	5.08	1.17	100	5.44	0.91	50	5.26	**0.025**	**0.042**
2	ELSA 2 (6 months)	4.66	1.28	85	5.04	1.31	48	4.85	0.098	0.093
3	ELSA 3 (12 months)	4.14	1.57	85	4.8	1.33	46	4.47	0.078	**0.014**
4	ELSA 4 (18 months)	3.9	1.62	77	4.5	1.53	46	4.2	0.369	0.114
5	ELSA 5 (24 months)	3.36	1.6	77	4.59	1.51	31	3.975	0.602	**0.001**
6	ELSA 6 (30 months)	2.55	1.47	61	4.3	1.62	21	3.425	0.148	**0.001**
7	ELSA 7 (36 months)	2.5	1.3	45	3.3	1.5	22	2.9	ns	ns
8	ELSA 8 (42 months)	2.46	1.25	29	3.14	1.41	11	2.8	ns	ns
9	ELSA 9 (48 months)	2.33	1.22	28	2.87	1.58	13	2.6	ns	ns
10	ELSA 10 (54 months)	2.19	1.4	18	2.61	1.2	8	2.4	ns	ns
11	ELSA 11 (60 months)	2.3	1.31	6	-	-	0	2.3	ns	ns
	Mean	3.224545			4.059					

Figure 5.

ADL of hospitalised and nonhospitalised AD patients for each ELSA determination

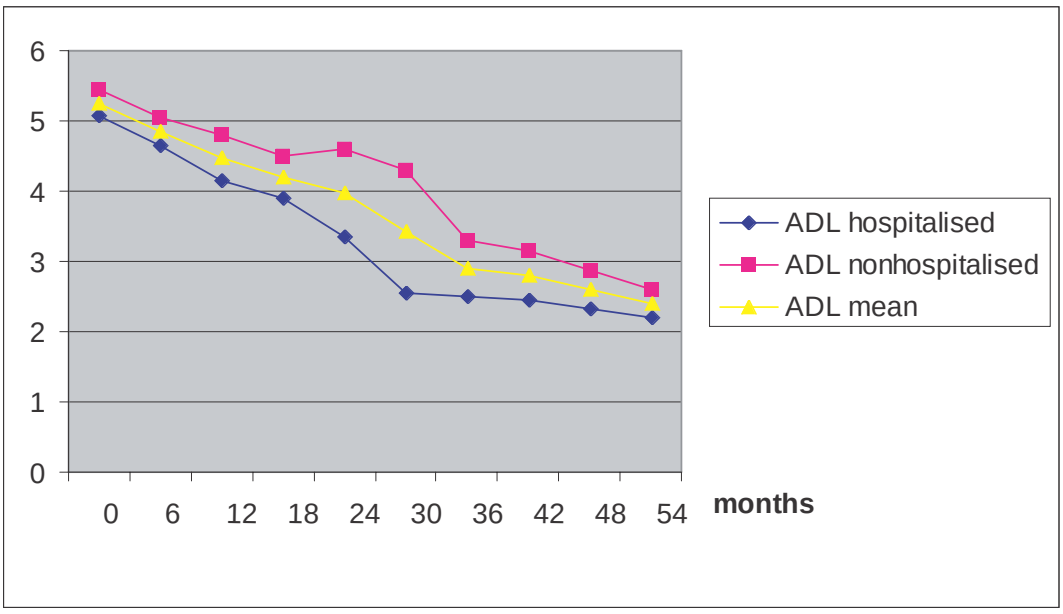

Table 8.

Cohen comparison and correlation for each ELSA determination

	No. ELSA	COHEN hospitalised			COHEN nonhospitalised			COHEN mean	p (Levene's Test)	p (t-test)
		mean	SD	N	mean	SD	N			
1	ELSA 1 (0 months)	22.54	10.15	100	22.46	9.44	50	22.5	**0. 36**	0.961
2	ELSA 2 (6 months)	22.66	9.38	85	21.24	7.28	48	21.95	0.244	0.351
3	ELSA 3 (12 months)	24.33	9.09	85	22.51	10.70	46	23.42	0.786	0.334
4	ELSA 4 (18 months)	26.71	9.46	77	21.18	7.11	46	23.945	0.103	**0.001**
5	ELSA 5 (24 months)	26.93	10.05	77	22.7	8.09	31	24.815	0.316	**0.026**
6	ELSA 6 (30 months)	25.4	10.33	61	24.52	6.75	21	24.96	ns	ns
7	ELSA 7 (36 months)	26.3	5.6	45	31.5	8.3	22	28.9	ns	ns
8	ELSA 8 (42 months)	24	8.45	29	25.6	6.33	11	24.8	ns	ns
9	ELSA 9 (48 months)	22.5	2.5	28	24.9	6.1	13	23.7	ns	ns
10	ELSA 10 (54 months)	24.5	5.3	18	26.5	3.41	8	25.5	ns	ns
11	ELSA 11 (60 months)	28.8	3.8	6	-	-	0	28.8	ns	ns
	Mean	24.97			24.311					

Figure 6.

Cohen of hospitalised and nonhospitalised AD patients for each ELSA determination

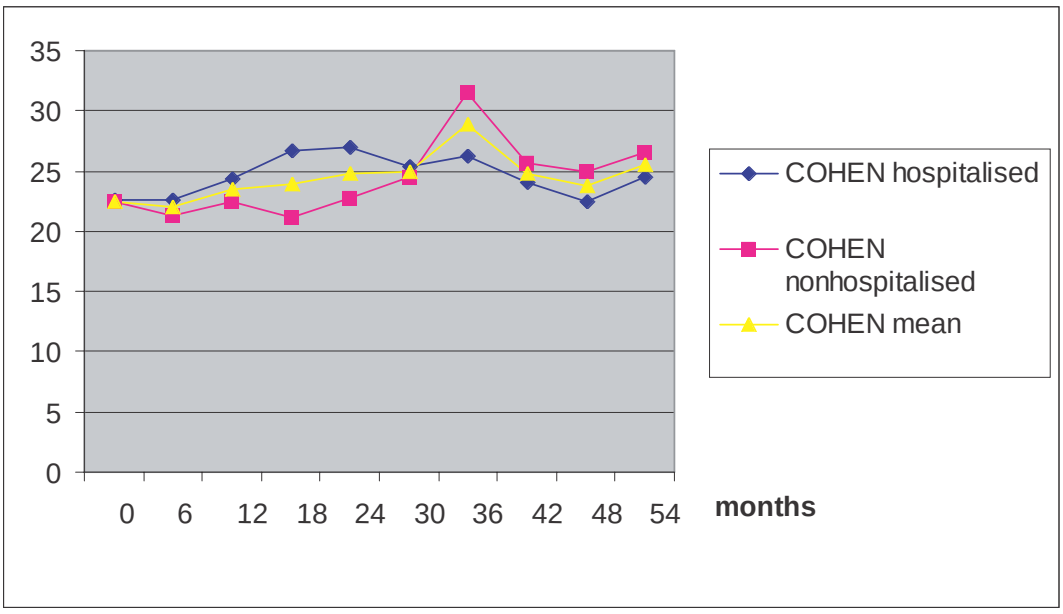

Table 9.

Number of hospitalisation correlations with MMSE, MNA, ADL and Cohen

	MMSE	MNA	ADL	COHEN
p (Spearman)	0.086	0.158	**0.006**	**0.019**

Table 10.

Duration of hospitalisation correlations with MMSE, MNA, ADL and Cohen

	MMSE	MNA	ADL	COHEN
p (Spearman)	0.776	0.869	0.442	0.500

Table 11.

MMSE comparison and correlation for short and long hospitalisation /year

Year	MMSE (short hospitalisation)	MMSE (long hosp)	MMSE (mean)	p (Levene's Test)	p (t-test)
1996	13.03	7.67	10.35	0.327	**0.001**
1997	11.08	11.4	11.24	**0.039**	0.845
1998	12.59	10.32	11.455	**0.008**	0.137
1999	12.35	9.07	10.71	**0.001**	**0.010**
2000	10.54	9.98	10.26	0.024	0.658
2001	9.05	15.85	12.45	0.16	**0.042**

Figure 7.

MMSE for short and long hospitalisations /year

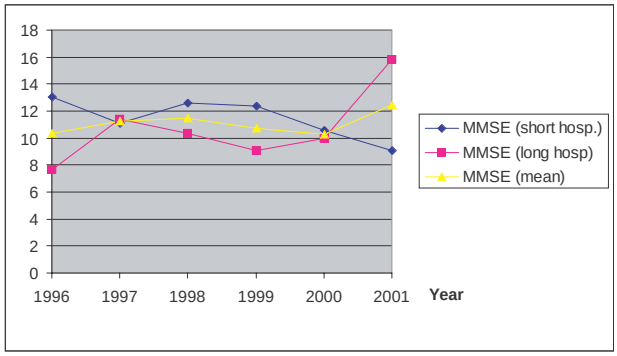

Table 12.

MNA comparison and correlation for short and long hospitalisation /year

Year	MNA (short hospitalisation)	MNA (long hospitalisation)	MNA (mean)	p (Levene's Test)	p (t-test)
1996	23.36	19.47	21.415	0.771	**0.014**
1997	22.28	24.05	23.165	**0.016**	0.147
1998	23.95	22.07	23.01	0.055	**0.023**
1999	21.9	21.87	21.885	0.108	0.970
2000	22.59	22	22.295	0.014	0.453
2001	24.09	25.43	24.76	0.922	0.193

Figure 8.

MNA for short and long hospitalisations /year

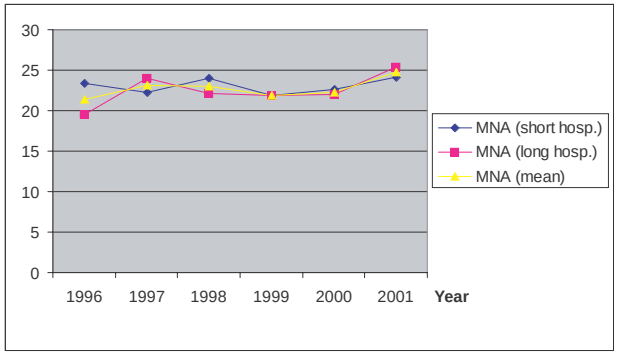

Table 13.

ADL comparison and correlation for short and long hospitalisation /year

Year	ADL (short hospitalisation)	ADL (long hospitalisation)	ADL (mean)	p (Levene's Test)	p (t-test)
1996	4.33	3.22	3.775	0.404	**0.001**
1997	4.09	4.36	4.225	0.440	0.485
1998	3.55	3.52	3.535	0.882	0.943
1999	4.03	3.31	3.67	0.710	0.075
2000	3.17	3.25	3.21	0.140	0.823
2001	2.68	3.18	2.93	**0.004**	**0.021**

Figure 9.

ADL for short and long hospitalisations /year

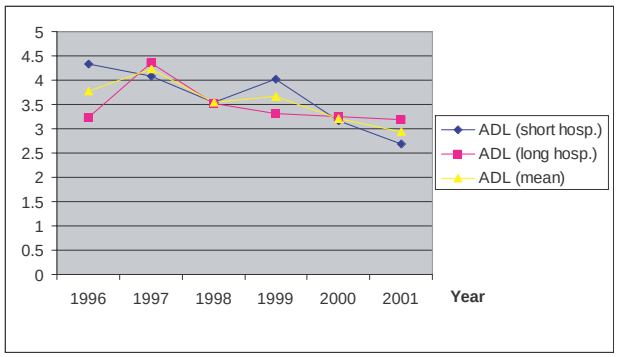

Table 14.

Cohen comparison and correlation for short and long hospitalisation /year

Year	COHEN (short hospitalisation)	COHEN (long hospitalisation)	COHEN (mean)	p (Levene's Test)	p (t-test)
1996	26.7	21.48	24.09	0.755	**0.013**
1997	22.78	24.4	23.59	0.651	0.495
1998	22.7	24.14	23.42	0.838	0.386
1999	25.75	27.12	26.435	0.136	0.401
2000	27.43	20.96	24.195	**0.007**	**0.001**
2001	27.61	32.85	30.23	0.437	**0.002**

Figure 10.

Cohen for short and long hospitalisations /year

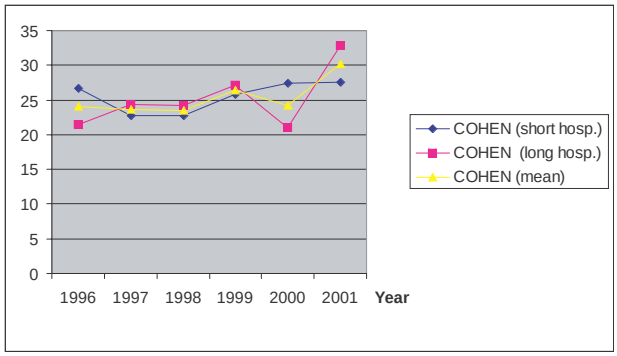

Table 15.

The effect of hospitalisation reasons on the variation of MMSE

	No. ELSA	MMSE hospitalised	MMSE infection	MMSE fall	MMSE malnutrition	MMSE behavioural problems
1	ELSA 1 (0 months)	14.96	16.55	17.33	13	15.25
2	ELSA 2 (6 months)	14.2	13.85	17.33	13.35	15.15
3	ELSA 3 (12 months)	12.02	11.84	13	11.25	12.45
4	ELSA 4 (18 months)	10.72	11.16	17.33	9.31	11.16
5	ELSA 5 (24 months)	8.93	8.45	11.5	8.44	9.16
6	ELSA 6 (30 months)	7.45	6.94	5.37	7.15	8.09

Figure 11.

The effect of hospitalisation reasons on the variation of MMSE

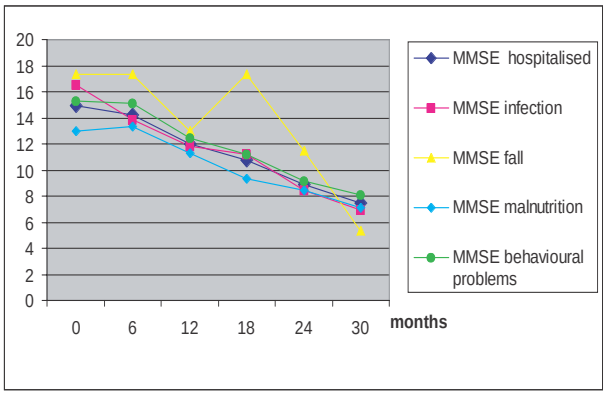

Table 16.

The effect of hospitalisation reasons on the variation of MNA

	No. ELSA	MNA hospitalised	MNA infection	MNA fall	MNA malnutrition	MNA behavioural problems
1	ELSA 1 (0 months)	22.35	25.31	24.58	22.49	22.43
2	ELSA 2 (6 months)	23.22	24.73	26	24.25	23.45
3	ELSA 3 (12 months)	23.58	23.3	25.5	23.26	24.13
4	ELSA 4 (18 months)	23.32	23.23	20.85	22.14	23.98
5	ELSA 5 (24 months)	22.52	21.8	23	22.45	21.38
6	ELSA 6 (30 months)	22.09	22.21	19.43	20.55	21.08

Figure 12.

The effect of hospitalisation reasons on the variation of MNA

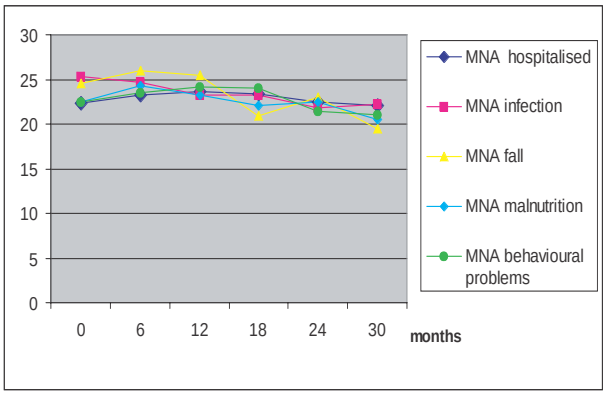

Table 17.

The effect of hospitalisation reasons on the variation of ADL

	No. ELSA	ADL hospi-talised	ADL infection	ADL fall	ADL malnu-trition	ADL behav-ioural prob-lems
1	ELSA 1 (0 months)	5.08	5.11	5.58	5.19	5.2
2	ELSA 2 (6 months)	4.66	4.85	5	4.58	4.86
3	ELSA 3 (12 months)	4.14	3.47	1.5	3.5	4.3
4	ELSA 4 (18 months)	3.9	3.44	3.75	3.17	4.5
5	ELSA 5 (24 months)	3.36	3.18	3.87	3.63	3.51
6	ELSA 6 (30 months)	2.55	2.61	2.5	2.44	2.76

Figure 13.

The effect of hospitalisation reasons on the variation of ADL

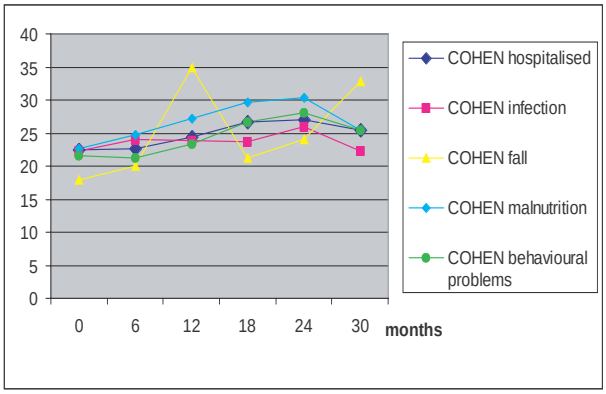

Table 18.

The effect of hospitalisation reasons on the variation of Cohen

	No. ELSA	COHEN hospi-talised	COHEN infection	COHEN fall	COHEN malnu-trition	COHEN behav-ioural problems
1	ELSA 1 (0 months)	22.54	22.22	17.83	22.66	21.54
2	ELSA 2 (6 months)	22.66	24	20	24.76	21.31
3	ELSA 3 (12 months)	24.33	23.78	35	27.12	23.37
4	ELSA 4 (18 months)	26.71	23.68	21.25	29.7	26.6
5	ELSA 5 (24 months)	26.93	25.9	24.12	30.38	28.07
6	ELSA 6 (30 months)	25.4	22.21	32.85	25.46	25.45

Figure 14.

The effect of hospitalisation reasons on the variation of Cohen

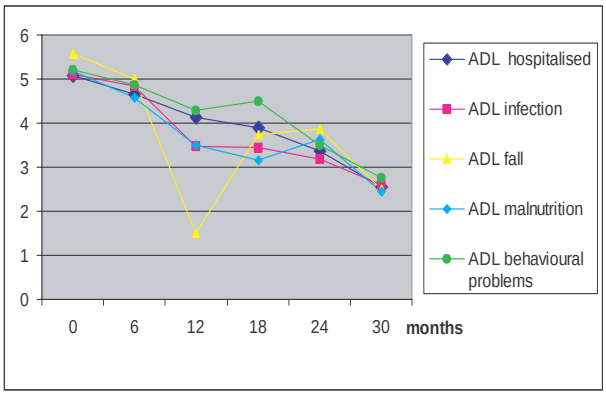

Table 19.

Infections effect on MMSE, MNA, ADL and Cohen

	MMSE infection	MNA infection	ADL infection	COHEN infection
p (Chi-Square)	0.336	0.336	**0.003**	0.804
p (Pearson)	0.84	0.601	**0.018**	0.409

Table 20.

Falls effect on MMSE, MNA, ADL and Cohen

	MMSE fall	MNA fall	ADL fall	COHEN fall
p (Chi-Square)	0.101	0.001	**0.001**	**0.001**
p (Pearson)	**0.001**	o.693	**0.001**	**0.001**

Table 21.

Malnutrition effect on MMSE, MNA, ADL and Cohen

	MMSE malnutrition	MNA malnutrition	ADL malnutrition	COHEN malnutrition
p (Chi-Square)	0.243	**0.001**	**0.05**	**0.040**
p (Pearson)	0.223	0.627	**0.009**	**0.004**

Table 22.

Behavioural problems effect on MMSE, MNA, ADL and Cohen

	MMSE behavioural problems	MNA behavioural problems	ADL behavioural problems	COHEN behavioural problems
p (Chi-Square)	**0.036**	**0.035**	**0.007**	0.070
p (Pearson)	**0.001**	0.024	**0.001**	0.921

Discussion

AD population of ELSA study is a representative one, both for hospitalised and nonhospitalised patients.

The high ratio of hospitalised patients (2:1) shows the importance of hospitalisation in the evolution of AD.

The comprehensive neuropsychological assessment was made at every 6 months; most frequent by patients had 4, 5 or 6 ELSA determinations (Table 1.).

The comparison between the mean values of neuropsychological parameters: MMSE, MNA, ADL and Cohen of hospitalised versus nonhospitalised AD patients using t-test shows significant differences for MNA ($p < 0.05$) and differences close to be significant for MMSE ($p = 0.068$), ADL ($p = 0.058$) and Cohen ($p = 0.07$)

The results have encouraged the authors to find significant differences and correlations between hospitalised populations having different hospitalisation parameters (number, duration, reasons) and nonhospitalised patients, or between different hospitalised populations.

As regards the number of hospitalisation, 40 % of patients had 1 hospitalisation, 26 % had 2 hospitalisations and 34 % had 3-7 hospitalisations in the 5 years of ELSA study.

The total number of hospitalisations of 100 AD patients is 229, with 125 long time hospitalisations and 104 short time hospitalisations. 1996, 1998 and 1999 are the years with a predominance of long time hospitalisations.

The comparison of neuropsychological parameters between hospitalised and nonhospitalised patients for each ELSA determination reveals:

- significant differences for MMSE at ELSA 3 (12 months) ($p = 0.036$), ELSA 5 (24 months) ($p = 0.026$) and ELSA 6 (30 months) ($p = 0.016$). The lower values of MMSE for hospitalised patients show that patients which need hospitalisation, generally have the cognitive functions more degenerated that those who don't. This result is sustained by correlations between hospitalisation and MMSE scores at ELSA 1 (0 months) and ELSA 2 (6 months) ($p = 0.024$) ($p = 0.007$), using Levene test. Thus, there is a strong correlation of cognitive functions and hospitalisation needs at the beginning of AD disease (in the first year following diagnosis).
- significant differences for MNA at ELSA 1 (0 months) ($p = 0.006$), ELSA 3 (12 months) ($p = 0.024$) and ELSA 4 (18 months) ($p = 0.034$). Correlations exist between hospitalisation and MNA scores at ELSA 1 (0 months) ($p = 0.001$) and ELSA 4 (18 months) ($p = 0.009$). Nutritional status and behaviour can influence the hospitalisation both in the first year following diagnosis and during the course of the disease by enhancing body degradation.
- significant differences for ADL at ELSA 1 (0 months) ($p = 0.042$), ELSA 3 (12 months) ($p = 0.014$), ELSA 5 (24 months) ($p = 0.001$) and ELSA 6 (30 months) ($p = 0.001$). Activities of daily living are influenced by hospitalisation; the ADL scores of nonhospitalised patients are generally higher, showing their relative independence.
- significant differences for Cohen scores at ELSA 4 (18 months) and ELSA 5 (24 months). There are no correlations between hospitalisation and behavioural problems.

As regards the correlation between the number of hospitalisations/patient and the neuropsychological parameters (Table 9.), ADL is strongly correlated ($p = 0.006$).

The frequency of hospitalisation influences the activities of daily living. There is also a correlation between behavioral problems of AD patients (Cohen) and the number of hospitalisations ($p = 0.019$).

The duration of hospitalisation is not generally correlated with the neuropsychological parameters (Table 10.).

Regarding the short and long hospitalisations/year, there are significant differences between:

- MMSE in 1996 ($p = 0.001$), 1999 ($p = 0.01$) and 2001 ($p = 0.0042$)
- MNA in 1996 ($p = 0.014$) and 1998 ($p = 0.023$)

- ADL in 1996 (p = 0.01) and 2001 (p = 0.021)
- Cohen in 1996 (p = 0.013),2000 (p = 0.001) and 2001 (p = 0.002).

Generally (excepting Cohen) the values for short time hospitalised patients are higher than those for long time hospitalised patients (showing a better mental and nutritional capacity and a higher autonomy).

There is a correlation between the duration of hospitalisation and MMSE (p < 0.05 in Levene test for 3 consecutive years) (Table 11.). For the other parameters, the correlations are not significant.

The effect of the most frequent hospitalisation reasons in AD patients on neuropsychological parameters for each ELSA is shown in Figures 11-14.

The influence of each reason on the neuropsychological parameters of hospitalised patients:

- for the reasons: infection, fall and behaviour problem, MMSE graphic has the same aspect as the MMSE of globally hospitalised patients.
- for the reasons: malnutrition and behavioural problems, MNA graphic has an appropriate aspect with those of MNA of globally hospitalised patients.
- for the reasons: infection, malnutrition and behavioural problems, both ADL and Cohen graphics have the appropriate aspect with that of globally hospitalised patients.

There is a significant difference between hospitalised population with and without :

- infection- regarding ADL parameters (p = 0.003)
- fall- regarding ADL (p = 0.001) and Cohen (p = 0.001)
- malnutrition- regarding MNA (p = 0.001), ADL (p = 0.05) and Cohen (p = 0.04)
- behavioural problems- regarding MMSE (p = 0.036), MNA (p = 0.035) and ADL (p = 0.007).

There are correlations between the following hospitalisation reasons and neuropsychological parameters:

- infection and ADL (p = 0.018)
- fall and ADL (p = 0.001), MMSE (p = 0.001), Cohen (p = 0.001)
- malnutrition and ADL (p = 0.009), Cohen (p = 0.004)
- behavioural problems and MMSE (p = 0.001), ADL (p = 0.001)

Conclusions

During the course of the disease, many Alzheimer's patients will need to be hospitalised due to the disease itself or due to associated diseases or life events. Several studies have been published in the past few years which report on long-term hospitalisation and nursing home care in Alzheimer's patients. However, the frequency, duration and the reasons for hospitalisation in Alzheimer's patients have previously not been published.

The aim of the present study is to evaluate if there is any significant differences between hospitalised and not hospitalised Alzheimer's patients and if there are correlations between the characteristics of hospitalisation (frequency, duration and the reasons of hospitalisation) and the geriatric and neuropsychological determinations of cognitive function in Alzheimer's disease patients.

We studied 150 patients who were participants in the ELSA study: a longitudinal study on the natural history of Alzheimer's disease between 1996 and 2001.

MMSE (Mini Mental Status Exam) assessing the level of cognitive functions (attention, verbal recall, calculation, language, praxis and orientation) was determined every 6 months.

Every patient was followed regarding hospitalisation parameters: number of hospitalisation, period of each hospitalisation (short time hospitalisation < 7 days, long time hospitalisation > 7 days), reasons of hospitalisation (infections, falls, behaviour problems, malnutrition).

Statistical analyses were performed for all factors regarding hospitalisation.

AD population of ELSA study is a representative one, both for hospitalised and nonhospitalised patients.

The predominance of hospitalised patients in ELSA cohort shows the importance of hospitalisation in the evolution of AD.

The comparison between the values of cognitive parameter MMSE shows significant differences and correlations between hospitalised populations having different hospitalisation parameters (number, duration, reasons) and nonhospitalised patients, or between different hospitalised populations.

The lower values of MMSE for hospitalised patients show that patients which need hospitalisation, generally have the cognitive functions more degenerated that those who don't need hospitalisation. This idea is sustained by correlations between hospitalisation and MMSE scores at ELSA 1 and ELSA 2 (p = 0.024) (p = 0.007), using Levene test. So, it is a strong correlation of cognitive functions and hospitalisation need at the beginning of AD disease (in the first year after diagnosis).

Regarding the short and long hospitalisations/year, there are significant differences between cognitive functions.

Generally the values for short time hospitalised patients are higher than those for long time hospitalised patients showing a better mental capacity.

There is a correlation between the duration of hospitalisation and MMSE (p = 0.05 in Levene test for 3 consecutive years).

The effect of the most frequent hospitalisation reasons in AD patients on neuropsychological parameters for each ELSA indicates significant difference between hospitalised population with and without behavioural problems regarding MMSE (p = 0.036).

There are correlations between the following hospitalisation reasons and neuropsychological parameters: fall and MMSE (p = 0.001),behavioural problems and MMSE (p = 0.001).

This five years study has to be continued for achieving sufficient data to make predictions for general effects of hospitalisation on evolution of cognitive function, ADL capacity and behaviour in AD.

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