


Risk factors for functional decline and institutionalisation among community-dwelling older adults with mild to severe Alzheimer’s disease: one year of follow-up

SIR—In view of the present demographic evolution, Alzheimer’s disease (AD) is becoming increasingly common in older people [1]. A better knowledge of the natural history of the disease, such as the risk factors for functional decline or institutionalisation, is useful for resource planning and medical strategies needed for the care of patients. However, most studies of AD only include patients in the mild to moderate stages of disease, omitting the great majority of cases that end with a stage of marked severity which may last many years. Moreover, the few published studies concerning this group have studied institutionalised patients [2].

The aim of this study is to determine the risk factors for institutionalisation and functional decline at 1 year in community-dwelling older patients with mild to severe disease.

Methods

Recruitment

Patients were recruited as part of a larger prospective longitudinal study between 1994 and 2002 in which 585 community-dwelling outpatients with AD aged >65 and ≤85 years were followed-up prospectively in the Alzheimer Centre of the Department of Internal Medicine and Clinical Gerontology at Purpan University Hospital, Toulouse, France. They had a Mini-Mental State Examination (MMSE) score [3] between 10 and 26.

Data collected

Sociodemographic and medical information and the measures of cognitive and non-cognitive performance were collected. Patient’s physical disability was quantified using activities of daily living (ADL) [4] and instrumental activities of daily living (IADL) scales [5], and balance disorders and risk for falls were evaluated by one-leg balance test [6]. Social and familial dimensions of the disease were assessed by the Zarit scale [7]. Institutionalisation occurring during the 1 year of follow-up was recorded. Psychological and behavioural disturbances were evaluated using two different scales: initially, the Cohen-Mansfield scale [8] and, later, the Neuropsychiatric Inventory [9].

Statistical analysis

At baseline, patients were classified into two groups according to the disease stage defined by MMSE score: mild to moderate (MMSE ≥16) and moderately severe to severe (MMSE <16). First, baseline parameters between the two groups (MMSE <16 group and MMSE ≥16 group) were compared. Second, bivariate analysis was conducted to compare the changes at 1 year in cognitive and non-cognitive parameters according to baseline MMSE score. Multivariate logistic regression analysis was performed to study the specific effect of factors associated with moderately severe to severe AD at baseline and with institutionalisation and functional decline at 1 year. Further details of the methods used (sampling, data collected and analysis) can be found in Appendix 1 in the supplementary data on the journal website (http://www.ageing.oxfordjournals.org/).

Results

At inclusion, multivariate analysis shows loss of ADL and IADL, age, altered one-leg balance test, BMI <25 kg/m² and not receiving specific Alzheimer treatment as significant independent factors correlated with MMSE <16.

Regarding living arrangements, at inclusion, the percentage of patients living alone at home is similar in both groups (20 versus 22%; P = 0.547). Caregiver burden is significantly higher among the MMSE <16 group. Eighteen per cent (n = 21) of subjects with an MMSE score <16 and 8.7% (n = 29) of patients with an MMSE score ≥16 are institutionalised at 1 year (OR 2.35, 95% CI 1.28–4.31, P = 0.004). After 1 year of follow-up, multivariate analysis is performed using institutionalisation as the variable to be explained. An increasing Zarit score and change in living arrangement...
appear as significant independent associated factors. Living alone or living with family present a higher risk of institutionalisation than living with spouse (P<0.002). However, an MMSE score <16 is not a significant independent factor correlated with institutionalisation (Table 1).

Regarding functional state, at baseline, patients with an MMSE score <16 present greater functional disability than those with an MMSE score ≥16 (P<0.001). Similarly, decline in function at 1 year is higher among subjects with an MMSE score <16 than those with an MMSE score ≥16 (ADL: 75.6 versus 43.2%, OR 4.08, 95% CI 2.55–6.53, P<0.001 and IADL: 65 versus 52.1%, OR 1.69, 95% CI 1.02–2.83, P = 0.044, respectively). When looking at the rate of functional decline during the 1 year of follow-up, a significant aggravation in each group for both ADL and IADL and a significant difference between groups concerning ADL at 1 year (P<0.001) are observed. At inclusion, balance impairment, assessed by the one-leg balance test, is significantly altered in patients with an MMSE score <16. After 1 year of follow-up, each group experiences a similar deterioration from normal to altered one-leg balance test performance (MMSE <16: 10.9% versus MMSE ≥16: 13.2%, OR 0.8, 95% CI 0.44–1.60, P = 0.535). Finally, at 1 year, multivariate analysis is performed using ADL aggravation as the variable to be explained. Altered one-leg balance test, disability in performing IADL, living at home alone and an MMSE score <16 appear as significant independent predictive factors correlated with the loss of independence (Table 2). For further details of clinical characteristics of the two groups at baseline and the evolution of both groups’ parameters at 1 year, please see Appendix 2 (Tables 1 and 2 respectively) in the supplementary data on the journal website (http://www.ageing.oxfordjournals.org/).

**Discussion**

In this study, caregiver burden is an independent factor associated with institutionalisation after 1 year of follow-up. Previous related findings show that psychological and behavioural disturbances, along with functional decline, are the most important risk factors for increasing caregiver burden and for nursing home placement [10, 11]. However, this study’s main limitation is the difficulty of paying close attention to behavioural problems. In fact, during the follow-up, two different evaluation scales have been used: initially, the Cohen-Mansfield scale and, later, due to the development of more effective tools, the Neuropsychiatric Inventory. Therefore, it is difficult to establish comparisons over time.

Regarding living arrangements, there is no difference seen in the percentage of subjects still living alone at home in both groups. In this study, after multivariate analysis, living alone at home is a significant independent predictive factor for institutionalisation. This finding goes along with a recent descriptive study which shows that patients with mild to moderate AD living alone at home are more frail (worse nutritional state, balance impairment and money income) than those living with a formal caregiver [12]. This result could also point towards the existence of associated factors, such as a preserved physical autonomy [13] or the use of non-medical services, which allow patients at moderately severe to severe stages to live independently at home.

In this study, altered one-leg balance test, disability in performing IADL, living at home alone and an MMSE score <16 are risk factors for functional decline in implementing ADL. Functional impairment increases with AD progression [14]. The loss of functional autonomy was a highly correlated factor with moderately severe to severe AD at inclusion and after 1 year of follow-up. This significant correlation still remains after multivariate analysis in which the moderately severe to severe stage of AD appears as an independent predictive factor for disability aggravation in performing ADL. The maintenance of performing ADL/IADL independently, known as functional autonomy, is an essential concept in geriatric medicine. Among older population, the loss of this function is a common manifestation of disease; in addition, it has prognostic connotations in treatment response, morbidity and mortality, and it is associated with an increase in hospitalisation, institutionalisation, greater use of health services and loss of economic self-sufficiency [15]. This is especially important

---

**Table 2. Factors associated with ADL aggravation after 1 year of follow-up**

<table>
<thead>
<tr>
<th>Multivariate analysis</th>
<th>OR</th>
<th>95% CI</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADL aggravation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MMS at baseline (&lt;16 versus ≥16)</td>
<td>1.41</td>
<td>1.04–1.92</td>
<td>0.03</td>
</tr>
<tr>
<td>Altered one-leg balance test (ref.: normal)</td>
<td>2.07</td>
<td>1.15–3.74</td>
<td>0.016</td>
</tr>
<tr>
<td>Living arrangements (ref.: with spouse)</td>
<td>2.62</td>
<td>1.75–3.90</td>
<td>0.0004</td>
</tr>
<tr>
<td>With family</td>
<td>1.96</td>
<td>1.10–3.54</td>
<td>0.02</td>
</tr>
<tr>
<td>Alone</td>
<td>2.17</td>
<td>1.28–3.68</td>
<td>0.0025</td>
</tr>
<tr>
<td>IADL (&gt;2 disabilities versus ≤2)</td>
<td>2.80</td>
<td>1.50–5.29</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

ADL, activities daily living; IADL, instrumental activities daily living; MMS, Mini-Mental State.

*Variable to be explained (1 disability versus none).

After adjustment for confounding factors (MMS, one-leg balance test, living arrangements, IADL, and Zarit score).

Overall P.

Hosmer and Lemeshow test.

---

**Table 1. Factors associated with institutionalisation after 1 year of follow-up**

<table>
<thead>
<tr>
<th>Multivariate analysis</th>
<th>OR</th>
<th>95% CI</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutionalisation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MMS at baseline (&lt;16 versus ≥16)</td>
<td>1.74</td>
<td>0.87–3.49</td>
<td>0.116</td>
</tr>
<tr>
<td>Living arrangements (ref.: with spouse)</td>
<td>3.30</td>
<td>1.23–9.49</td>
<td>0.0025</td>
</tr>
<tr>
<td>With family</td>
<td>3.00</td>
<td>1.17–7.91</td>
<td>0.0007</td>
</tr>
<tr>
<td>Alone</td>
<td>4.43</td>
<td>2.01–9.29</td>
<td>0.0025</td>
</tr>
<tr>
<td>Zarit (ref.: 0–20)</td>
<td>1.21</td>
<td>0.46–3.16</td>
<td>0.693</td>
</tr>
<tr>
<td>20–40</td>
<td>3.33</td>
<td>1.30–8.53</td>
<td>0.0125</td>
</tr>
<tr>
<td>&gt;40</td>
<td>3.33</td>
<td>1.30–8.53</td>
<td>0.0125</td>
</tr>
</tbody>
</table>

MMS, Mini-Mental State.

*Variable to be explained (yes versus no).

After adjustment for confounding factors (MMS, living arrangements and Zarit score).

Overall P.

Hosmer and Lemeshow test.

---

**Table 3. Factors associated with IADL aggravation after 1 year of follow-up**

<table>
<thead>
<tr>
<th>Multivariate analysis</th>
<th>OR</th>
<th>95% CI</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>IADL aggravation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MMS at baseline (&lt;16 versus ≥16)</td>
<td>1.35</td>
<td>1.01–1.83</td>
<td>0.043</td>
</tr>
<tr>
<td>Altered one-leg balance test (ref.: normal)</td>
<td>1.40</td>
<td>1.03–1.91</td>
<td>0.033</td>
</tr>
<tr>
<td>Living arrangements (ref.: with spouse)</td>
<td>1.84</td>
<td>1.23–2.75</td>
<td>0.0025</td>
</tr>
<tr>
<td>With family</td>
<td>1.68</td>
<td>1.04–2.74</td>
<td>0.033</td>
</tr>
<tr>
<td>Alone</td>
<td>1.84</td>
<td>1.23–2.75</td>
<td>0.0025</td>
</tr>
</tbody>
</table>

IADL, instrumental activities daily living; MMS, Mini-Mental State.

*Variable to be explained (1 disability versus none).

After adjustment for confounding factors (MMS, one-leg balance test, living arrangements, IADL, and Zarit score).

Overall P.

Hosmer and Lemeshow test.
in older adults with AD. The loss of functional autonomy leads to a progressive dependency which evolves into a loss of quality of life and loss of dignity.

Patients with dementia experience greater impairment of gait and balance than elderly with normal cognition [16]. In this study, patients at more severe stages of the disease presented more balance disturbances than those at moderate to mild stages and, on the contrary, patients at all stages suffered a continuous alteration in one-leg balance test throughout the year of follow-up. After multivariate analysis at 1 year, altered one-leg balance test appeared as an independent factor associated with the aggravation of performing ADL; therefore, it could be considered as a predictor of functional decline in elderly with AD. Thus, regular physical exercises focusing on the maintenance of balance could be an important part of the systematic management of patients with AD.

Following on from the results of this study, future research is needed to evaluate the effect of (i) interventional physical programmes (to maintain IADL and balance) on preventing functional decline in AD patients, including those at the more severe stages of the disease, and (ii) well-planned follow-up and home support (including medical and non-medical services) to reduce caregiver burden and, thus, to possibly delay or prevent inappropriate institutionalisations.

Key points
- A well-planned follow-up and home support (including medical and non-medical services) could diminish caregiver burden, allowing for a delay in institutionalization for older AD adults, including those in moderately severe to severe stages.
- Preventing functional decline interventional programmes (such as the rehabilitation of balance disorders or the maintenance of IADL) in AD older patients should be tested to evaluate its effect on preserving their functional capacities in order to live with as much independence and for as long as possible, all in terms of improving their quality of life.

Funding
This work was supported by a grant from the Clinical Research Hospital Program from the French Ministry of Health (PHRC No. 98-47N, PHRC No. 0101001).

Conflicts of interest declaration
None declared.

References

doi:10.1093/ageing/afj059
Published electronically 13 March 2006