Increasing prevalence of dementia among very old people

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Abstract

Background: it is unknown whether the age-specific prevalence of dementia among the very old changes over time.

Methods: this study compares the prevalence of dementia in two population-based cross-sectional samples of very old people in northern Sweden in 2000–02 and in 2005–07. In total, 430 individuals aged 85 and older (mean age 89.5 years, 71.4% women) were evaluated for dementia in the first cross-section and 465 individuals (mean age 90.2 years, 70.9% women) in the second. Trained assessors performed assessments and interviews during home visits and collected information from carers, relatives and medical records. Dementia was diagnosed according to the Diagnostic and Statistical Manual of Mental Disorders, fourth edition criteria.

Results: the prevalence of dementia in the total sample was 26.5% in 2000–02 and 37.2% in 2005–07 (P = 0.001). There was also an increase in the prescription of different antihypertensive agents, antilipemic agents and choline esterase inhibitors, and more people had had heart surgery in the later sample.

Conclusions: in this sample of very old people, an increase in the age-specific prevalence of dementia was detected over 5 years. Possible reasons for this may be extended survival among individuals with risk factors for dementia and among individuals with established dementia.

Keywords: dementia, aged, 80 and over, cross-sectional study, prevalence, epidemiology, elderly

Introduction

The section of the population aged 80 and above is projected to comprise one and a half percent of the world’s total population in 2010, a proportional increase of 50% since 1990 [1]. This makes the very old the fastest growing age group in the world today. Reduced incidence of and increased survival after cardiovascular events may be one contributory reason for this [2]. That a larger proportion of very old survive also means there are more individuals at risk of contracting the diseases of the very old, such as dementia.

In 2000, the number of cases of dementia worldwide was estimated at ~25.5 million, of which 38% were male. The expected increase in dementia prevalence has been estimated as between 14 and 28% per decade in the developed world [3]. Another estimate, assuming no changes in mortality, predicts that the prevalence will double every 20 years [4]. Reported risk factors for dementia are old age, female gender, hypertension and stroke [5–7]. Low level of education and the apolipoprotein E4 allele have also been reported as risk factors for Alzheimer’s disease [8].

Earlier reports on age-specific dementia prevalence vary between 22.4 and 37.8% for the age group 85–89, between 31.5 and 37.8% among 90–94 year olds, and 38.1 and 47.9% in those aged 95 years and older [9–13]. Studies exploring possible changes over time of either dementia prevalence or incidence have produced contradictory results [14–17].

Any prognosis made about dementia prevalence must be considered with caution since one cannot know exactly which factors will influence these numbers. It is possible that the prevalence within age groups will remain constant even though the population as a whole grows older, or extended survival of old people with dementia or risk factors for dementia such as hypertension and stroke could
increase the age-specific prevalence of the disease. It is of interest to know whether a hypothetical increase in dementia is due to more people reaching very old age or to an actual increase in age-specific prevalence.

**Aim**

The aim of the present study was to assess whether the age-specific prevalence of dementia in a sample of very old people changed over time, as measured in two cross-sectional samples 5 years apart.

**Method**

The study draws on the population-based Umeå 85+/GErontological Regional Database (GERDA) material. The participants were interviewed and assessed in their homes, either in the community or in an institution.

**Participants**

Umeå is an urban municipality in the county of Västerbotten, Sweden. Half the population of 85 year olds living in Umeå on 1 January 2000, were included in the study. The 85 year olds were alternately assigned to participation or non-participation from a randomised starting point in the National Tax Board register. The total population of 90 year olds and 95 year olds and older from Umeå were also selected for participation. No additional inclusion criteria were set. The same inclusion procedure was carried out in five rural municipalities in the same county on 1 January 2002.

The names, addresses and civil registration numbers were collected from the National Tax Board. The process was repeated identically 5 years later, with the same age groups, i.e. every other 85-year-old, 90 year olds and those aged 95 years and older. Any survivors from the first data collection were included again in the subsequent cross-section in the appropriate age-group. Mean time (±Standard Deviation (SD)) from inclusion to first contact with the participant was 8.3 ± 4.4 months in the first cross-section and 10.6 ± 5.2 months in the second cross-section. The design has been described in greater detail elsewhere [18].

**Procedure**

The eligible participants were contacted by letter giving information about the study and again 2 weeks later by telephone so that they could give their informed consent to participate. If they were living in institutions, the caring staff was asked to evaluate the respondent’s cognitive capabilities and informed consent was then obtained either from the participant or from their next of kin. In some cases, only partial consent was given, most often consent to access medical records and to interview caring staff and relatives. The individuals participating were then administered structured interviews, including (but not limited to) several different assessment scales for measuring various aspects of health. Trained assessors who were physicians, nurses, physical therapists or medical students performed the assessments during one or more home visits.

During the interview process, if sufficient information could not be gained from the subject, carers and/or close relatives were contacted for complementary information. Data were also collected from all available medical records; from hospitals, from general practitioners and from caring institutions. There was an increased proportion of people who declined to participate (P = 0.003) in the second data collection. The two data collections were performed in similar time-frames, and during corresponding times of the year. The oldest individuals were assessed first. Three hundred and fifty-three participants met with an assessor in the first cross-section and 377 in the second cross-section.

A flow chart over the intended participants and the final samples can be seen in Figure 1. The Regional Ethical Review Board in Umeå approved the study (§99–326, §00–164 and §05–063M).

**Assessments and diagnoses**

The Mini Mental State Examination (MMSE) was used to assess cognitive functions [19, 20]. This scale was developed by Folstein et al. as a screening test to quantitatively assess the level of cognitive impairment in individuals and to document cognitive changes that occur over time. It ranges from 0 to 30 and a higher score indicates better cognition.

The Organic Brain Syndrome (OBS) scale was developed to assess symptoms appearing in delirium, dementia and other organic mental disorders [21, 22]. The scale is subdivided into OBS 1 (which is a questionnaire measuring the individual’s awareness and orientation to their own data) and OBS 2 (which is based on the observation of the person and describes a wide spectrum of psychopathology, such as suspiciousness, emotional reactions, delusions, hallucinations, speech disturbance, spatial orientation, recognition, physical and practical abilities, as well as variations in the person’s clinical state). In GERDA/Umeå 85+, only subscale two was used since OBS 1 gives information similar to that obtained from the MMSE. The OBS scale was mainly used to differentiate between dementia and delirium in the present study.

Depression was screened for using the Geriatric Depression Scale, 15-item version (GDS-15) [23]. The scale consists of 15 yes/no questions, and is designed to avoid bias from somatic ailments. The GDS-15 is a useful tool in screening for depressive symptoms in the very old and has been shown to have high sensitivity and specificity for detecting depression [24].

Activities of daily living (ADL) were assessed using the Barthel ADL Index, with the maximum score of 20 indicating total independence in personal ADL [25]. Height and weight were measured and body mass index (BMI) was calculated. The dementia and delirium diagnoses...
were made by a specialist in geriatrics, according to the criteria set out in the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV) [26]. Support for a diagnosis was gathered from medical records, medical history, information from relatives and caregivers, and the MMSE and OBS scales. If a diagnosis was cited in the medical records, its plausibility was evaluated. During collection of the first sample, a few etiologically uncertain cases of dementia were assessed at the Geriatric Centre in Umeå. Subclassification of Alzheimer’s dementia and vascular dementia were also made based on the criteria in the DSM-IV, in the same fashion.
Statistics

Dichotomous variables were analysed using the Pearson $\chi^2$ test, or two-sided Fisher exact test if expected cell count was below five. Continuous variables were analysed with the independent samples $t$-test. To control for different case mix between the two cross-sectional samples, a logistic regression analysis was performed including age and sex. A $P$-value of <0.05 was regarded as statistically significant.

Results

The prevalence of dementia in the total sample was 26.5% in 2000–02 and 37.2% in 2005–07, $P = 0.001$ (Table 1). The MMSE score was also significantly lower in the later sample.

In 2000–02, a total of 430 individuals (71.4% women) with a mean age of 89.5 years were assessed for dementia. In 2005–07 the corresponding figures were 465 individuals (70.1% women) with a mean age of 90.2 years.

Table 1. Clinical characteristics of the cross-sectional samples

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (%) of subjects (2000–02)</th>
<th>No. (%) of subjects (2005–07)</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dementia</td>
<td>114 (26.5%)</td>
<td>173 (37.2%)</td>
<td>0.001</td>
</tr>
<tr>
<td>Proportion of women</td>
<td>307 (71.4%)</td>
<td>326 (70.1%)</td>
<td>0.672</td>
</tr>
<tr>
<td>Living alone</td>
<td>338 (86.2%)</td>
<td>360 (82.0%)</td>
<td>0.098</td>
</tr>
<tr>
<td>Living in institutions</td>
<td>168 (39.1%)</td>
<td>181 (41.0%)</td>
<td>0.571</td>
</tr>
<tr>
<td>Heart surgery</td>
<td>9 (2.1%)</td>
<td>22 (4.7%)</td>
<td>0.031</td>
</tr>
<tr>
<td>Stroke</td>
<td>81 (18.8%)</td>
<td>103 (22.2%)</td>
<td>0.220</td>
</tr>
<tr>
<td>Heart disease</td>
<td>246 (57.3%)</td>
<td>294 (63.4%)</td>
<td>0.066</td>
</tr>
<tr>
<td>Diabetes</td>
<td>51 (11.9%)</td>
<td>62 (13.3%)</td>
<td>0.507</td>
</tr>
<tr>
<td>Warfarine</td>
<td>11 (2.6%)</td>
<td>14 (3.0%)</td>
<td>0.681</td>
</tr>
<tr>
<td>ASA</td>
<td>158 (36.7%)</td>
<td>192 (41.3%)</td>
<td>0.164</td>
</tr>
<tr>
<td>Diuretics</td>
<td>188 (43.7%)</td>
<td>230 (49.5%)</td>
<td>0.085</td>
</tr>
<tr>
<td>Beta blockers</td>
<td>82 (19.1%)</td>
<td>178 (38.3%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Calcium channel blockers</td>
<td>37 (8.6%)</td>
<td>59 (12.7%)</td>
<td>0.049</td>
</tr>
<tr>
<td>ACE inhibitors</td>
<td>41 (9.5%)</td>
<td>76 (16.3%)</td>
<td>0.003</td>
</tr>
<tr>
<td>Antilipemic agents</td>
<td>1 (0.2%)</td>
<td>23 (4.9%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>66 (15.3%)</td>
<td>82 (17.6%)</td>
<td>0.358</td>
</tr>
<tr>
<td>Antipsychotics</td>
<td>61 (14.2%)</td>
<td>64 (13.8%)</td>
<td>0.855</td>
</tr>
<tr>
<td>Benzodiazepines</td>
<td>114 (26.5%)</td>
<td>136 (29.2%)</td>
<td>0.362</td>
</tr>
<tr>
<td>Choline esterase inhibitors</td>
<td>8 (1.9%)</td>
<td>24 (5.2%)</td>
<td>0.011</td>
</tr>
<tr>
<td>NSAIDs</td>
<td>36 (8.4%)</td>
<td>37 (8.0%)</td>
<td>0.821</td>
</tr>
<tr>
<td>Number of medicines</td>
<td>5.99 ± 4.7</td>
<td>6.65 ± 4.1</td>
<td>0.026</td>
</tr>
<tr>
<td>Barthell’s ADL, 10 item</td>
<td>15.6 ± 6.3</td>
<td>15.6 ± 6.0</td>
<td>0.870</td>
</tr>
<tr>
<td>GDS-15 score</td>
<td>3.8 ± 2.6</td>
<td>3.7 ± 2.7</td>
<td>0.026</td>
</tr>
<tr>
<td>Systolic blood pressure</td>
<td>147.7 ± 24.1</td>
<td>144.4 ± 23.3</td>
<td>0.058</td>
</tr>
<tr>
<td>BMI</td>
<td>24.7 ± 4.7</td>
<td>24.8 ± 4.1</td>
<td>0.773</td>
</tr>
<tr>
<td>Years in school</td>
<td>6.2 ± 1.9</td>
<td>6.8 ± 2.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>MMSE</td>
<td>21.6 ± 8.0</td>
<td>19.8 ± 7.8</td>
<td>0.002</td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
<td>0.118</td>
</tr>
</tbody>
</table>

Individual variables may have lower denominators than the dementia variable.

ASA, acetylsalicylic acid; ACE, angiotensin converting enzyme; NSAID, non-steroidal anti inflammatory drug; ADL, activities of daily living; GDS-15, geriatric depression scale 15 item version; BMI, body mass index; MMSE, mini mental state examination.

Controlled for differences in age and sex between the samples using logistic regression, the prevalence of dementia increased between the two samples (odds ratio: 1.587, 95% confidence interval: 1.185–2.127, $P = 0.002$).

In the total sample, more people had had heart surgery and were treated with beta blockers, calcium channel blockers, Angiotensin Converting Enzyme (ACE) inhibitors, antilipemic agents and choline esterase inhibitors (Table 1).

In the 85-year-old group, prevalence of dementia was 17.4% in 2000–02 and 28.2% in 2005–07, $P = 0.017$. The corresponding figures for the 90 year olds were 24.0 and 39.8%, $P = 0.003$, and for the 95-year-old and older group 46.1 vs. 45.0%, $P = 0.874$ (Table 2).

In 2005–07, significantly more of the 85 year olds had dementia, had had heart surgery and were treated with antihypertensive medication such as ACE-inhibitors and beta blockers (Table 2). There was also an increase in the use of antilipemic agents in this age group. The later sample of 85 year olds also had significantly lower systolic blood pressure and MMSE scores.

The 2005–07 group of 90 year olds also had a higher proportion with dementia, lower MMSE scores, higher proportion treated with beta blockers and choline esterase inhibitors but their blood pressure was not significantly lower than the earlier sample.

The ≥95 year olds in the 2005–07 group had a similar proportion of participants with dementia and no significant difference in MMSE score but a larger proportion with heart diseases and a larger proportion of participants treated with beta blockers, diuretics and calcium channel blockers when compared with the earlier sample.

Among men in the total sample, the prevalence of dementia was 24/124 (19.5%) in 2000–02 and 39/139 (28.1%) in 2005–07, $P = 0.166$. Among women in the total sample, prevalence was 95/307 (30.9%) in the first cross-section, and 134/326 (41.1%) in the second ($P = 0.008$).

When divided geographically, the urban municipality showed a prevalence of dementia of 28.6 and 39.9% 5 years later ($P = 0.004$) while the prevalence in the rural areas was 25.5% in the first cross-section and 32.1% in the second ($P = 0.166$).

The proportion of people with Alzheimer’s disease to vascular dementia was 47–26 (64.4%) in the first cross-section and 84–45 (65.1%) in the subsequent ($P = 0.917$).

Discussion

The prevalence of dementia increased between 2000–02 and 2005–07 in the total sample, controlled for age and sex. There was also a significant, age-specific, increasing prevalence among the 85 and 90 year olds. A corresponding decrease in MMSE scores was also found in the total sample and in the 85 and 90 year olds. During the same period, there was an increased proportion of participants who had had surgery for cardiovascular diseases as well as increased treatment with drugs against cardiovascular disease and dementia symptoms.
An increasing proportion of the population have survived to reach a higher age during recent decades, at least in part because of a better treatment of cardiovascular risk factors such as hypertension, hyperlipidaemia and diabetes. Reduced mortality from cardiovascular disease such as myocardial infarction and stroke has been reported [2, 27], and also increased survival after stroke, probably due to better secondary prevention and rehabilitation [27]. Furthermore, coronary surgery such as coronary artery bypass graft (CABG) has also been made available to older people, which applied particularly to the 85 year olds in the present study. This might indicate that a larger proportion of people with cardiovascular risk factors survive to reach a higher age and are, therefore, exposed to a greater risk of developing dementia. These changes could at least partially explain the increasing proportion of individuals with dementia in the present study.

The average number of years in school increased [16, 17], consequently in 2001 without PROGRESS in old African Americans in 1992 and subsequently in 2001 without finding significant change in dementia prevalence. Other studies with similar aim and method are now relatively old [16, 17].

Better treatment of malignancies [29] might also increase the proportion of people reaching very old age but, since malignancies do not constitute known risk factors for dementia, increased survival would probably only contribute to a higher number of cases but not a higher proportion of people with dementia.

Another possible explanation could be that people with dementia, perhaps due to better care and drug treatment, survive longer with their dementia. In the present study, a larger proportion of participants with dementia were treated with choline esterase inhibitors in the 2005–2007 group, indicating a more active treatment approach.

Previous studies of change over time in age-specific prevalence of dementia have not shown any significant increase in age-specific dementia rates. Lobo et al. measured the prevalence of dementia in a Spanish region with a cross-sectional study conducted in 1988–89. A second study was made during 1994–96, which allowed for measurement of change over time. Lobo et al. [14] did not find any significant change in dementia prevalence. Hall et al. [30] examined rates of dementia among old African Americans in 1992 and subsequently in 2001 without finding significant change in dementia prevalence. Other studies with similar aim and method are now relatively old [16, 17].

### Methodological considerations

One methodological strength is that the data collection and diagnostic procedure were identical for both cross-sections. The increasing proportion of participants with a dementia...
diagnosis is also supported by the lower MMSE score among those assessed in 2005–07.

Limitations include the relatively small sample and the possibility of any change in documentation habits and procedures in the medical records between the two study periods. It is possible that during this time period, the general practitioners have improved their knowledge about dementia which might in turn have resulted in earlier detection. Another possible limitation is the clinical diagnosis, which might be less accurate than a comprehensive dementia examination, including brain imaging. There was also a higher proportion of individuals who declined to participate in the later cross-section.

This study seems to be one of the first to report a significantly increasing age-specific prevalence of dementia among very old people. These results have to be confirmed in other and larger samples but if this increase in proportion is valid, it has implications for the projected funding of dementia-related care in the future.

Key points

- The age-specific prevalence of dementia in the total sample had increased from 26.5 to 37.2% between 2000–02 and 2005–07.
- In the later sample a larger proportion were treated with beta blockers, ACE inhibitors, antilipemic agents, calcium channel blockers, choline esterase inhibitors and had had heart surgery.
- Possible causes of the increasing prevalence of dementia could be extended survival of people with dementia but also a reduction in cardiovascular mortality as an increasing proportion had received treatment for cardiovascular risk factors.

Conflict of interest

None declared.

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References

Central auditory function in early Alzheimer's disease and in mild cognitive impairment

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Abstract

Objective: to investigate auditory function in subjects with early Alzheimer's disease, mild cognitive impairment and with subjective memory complaints, in search of signs of central auditory processing dysfunction even in early stages of cognitive impairment.

Design and subjects: a consecutive group of men and women, referred to the Memory Clinic at the Karolinska University Hospital, was approached for inclusion in this prospective study. One hundred and thirty-six subjects, mean age 64 years (range 50–78 years), diagnosed with Alzheimer's disease (n = 43), mild cognitive impairment (n = 59) or with subjective memory complaints (n = 34), were included.

Methods: auditory function was assessed with pure tone audiometry, speech perception in quiet and in background noise and dichotic digits tests with two or three digits.