Prevalence of Ageing-associated Cognitive Decline in an Elderly Population

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Summary
Different diagnostic definitions have been proposed for use in the characterization of mild cognitive disorders associated with ageing. Previously, we reported a high (38.4%) prevalence of age-associated memory impairment (AAMI) using the National Institute of Mental Health criteria in an elderly population. Recently, a work group of the International Psychogeriatric Association proposed criteria for 'ageing-associated cognitive decline' (AACD). The objective of this study was to evaluate the prevalence of AACD in an elderly population. We examined 403 randomly selected subjects (68-78 years of age) with tests of memory, cognitive processing, attention, verbal and visuoconstructive functions and with a structured questionnaire for health status and subjective complaints of cognitive decline. In all, 26.6% of the subjects (24.4% of women, 30.1% of men) fulfilled the AACD criteria. The prevalence was slightly related to age and education. The rate was lowest in the oldest age group of 75-78 years (20.5%) and highest in the age group of 71-74 years (30.5%). Subjects with less than 4 years of education had the lowest (14.3%) and subjects with more than 6 years of education had the highest rate (29.4%) for AACD. However, the differences between these subgroups were not statistically significant. These results suggest that the prevalence of AACD is lower than that of AAMI. As AAMI tends to identify a very heterogeneous subject group, the AACD diagnosis, which takes into account age and education specific norms in its inclusion criteria, might prove superior to AAMI in differentiating a meaningful subgroup from an elderly population both for research purposes and in clinical settings.

Introduction
The decline in memory and other cognitive abilities during ageing is well documented [e.g. 1, 2]. However, the diagnostic classifications aimed to characterize elderly individuals with different degrees of cognitive decline (but not demented) are not established. Recently, a working party of the International Psychogeriatric Association (IPA) in collaboration with the World Health Organization (WHO) proposed diagnostic criteria for 'ageing-associated cognitive decline' (AACD) to categorize a group of subjects with cognitive decline falling short of dementia [3]. The criteria include the presence of subjective gradual cognitive decline (for at least 6 months) and objective evidence of abnormal performance in any principal domain of cognition, i.e. memory and learning, attention and concentration, thinking, language or visuospatial functioning. The abnormality is defined as performance at least one standard deviation (SD) below the age and education norms in well standardized neuropsychological tests. Furthermore, there must be no evidence of any medical condition known to cause cerebral dysfunction. Thus, the AACD diagnosis identifies persons with subjective and objective evidence of cognitive decline which does not impair function to warrant a diagnosis of dementia. The criteria leave open the question of progression. For some subjects, AACD may precede dementia, whereas for others it may be a relatively stable condition.

The AACD diagnosis is related to 'age-associated memory impairment' (AAMI), a condition characterized in the criteria proposed by a working group of the National Institute of Mental Health [4]. However, the AAMI diagnosis is based on a less comprehensive evaluation which takes into account memory function only. The AAMI criteria also differ from the AACD criteria in that the subjects are classified as having AAMI if they score 1 SD below the mean of younger adults (not people of their own age) in a standardized memory test. In spite of many supporting reports [5-8] and the high prevalence of AAMI [9], the significance of this condition has remained controversial [10-12].

AACD has to be differentiated also from 'mild cognitive disorder' (MCD), a classification included in the research criteria for ICD-10 by WHO [13]. This diagnosis is used only when there is an indication of a disease or condition known to cause cerebral
dysfunction. Yet another related concept is included in DSM-IV [14] as 'age-related cognitive decline' and defined as 'an objectively identified decline in cognitive functioning consequent to the ageing process that is within normal limits given the person's age'.

The purpose of this study was to evaluate the prevalence rate of AACD in a randomly selected sample of elderly people by applying the criteria proposed by the IPA working party. The associations of age, sex and education with prevalence rates were also evaluated. Furthermore, we examined the diagnostic value of a neuropsychological test battery for identifying AACD subjects.

Subjects and Methods
A random sample of 592 persons, 68–78 years of age, was drawn from the Kuopio population register. Of these subjects 79 had died and 11 had moved outside the study area before they were contacted. Of the remaining 502 subjects, 403 (80.3%) were evaluated. Of those not participating in the study, 17 were too ill to participate, 53 refused to participate and 27 could not be contacted. The study population has been described previously as a part of a report on the prevalence of AAMI [9]. The mean age of the participants was 71.3 years (SD 3.1, range 68–78). Women were somewhat older than men (71.9 vs. 71.0). The mean duration of formal education was 6.7 years (SD 3.4, range 0–18) with no difference between women and men. The proportions of women, 246 (61%), and men, 157 (39%), are similar to those in the total population (64%/36%) for this age group in the study area. The most frequent previous diagnoses were coronary heart disease (34%), hypertension (33%), cardiac arrhythmia (17%) and transient ischaemic attack (16%). The following diseases with frequent previous diagnoses were coronary heart disease (34%), hypertension (33%), cardiac arrhythmia (17%) and transient ischaemic attack (16%). The following diseases with possible direct negative effect on cognitive functions were considered as exclusion of AACD: stroke (7%), brain haemorrhage (2%), diabetes (7%), psychiatric disorder (9%), malignancy (6%). The participants who scored poorly in the neuropsychological tests were invited to the further evaluation for possible dementia. A total of 23 (5.7%) subjects fulfilled the DSM-III criteria of dementia (unpublished data) which also was an exclusion for AACD. Of the 403 participants, 402 had data complete enough for the classification of AACD and are included in the analyses. All subjects participating in the study gave their informed consent. The Ethics Committee of the University of Kuopio approved the study.

All participants underwent a structured interview for demographic information, medical history, current medication, smoking and alcohol consumption, and subjective assessment of memory disturbances and depression during the past year. Subjective complaints of memory loss were recorded by the Memory Complaint Questionnaire (MAC-Q) [15], in which a score of 25 or over is considered as indicating subjective memory loss. A test battery of brief neuropsychological tests was used to evaluate different cognitive domains essential for the identification of AACD. The following scores of tests were used: (1) Memory: The Buschke–Fuld Selective Reminding Test (BSRT) [16], the score is the total recall in six trials (max. 60). (2) Attention: The Trail-Making Test, Version A (TMT-A) [17], the score is the time in seconds (max. time limit 150 s.). (3) Effortful cognitive processing: The Trail-Making Test, Version C (TMT-C) [17, 18], the score is the time in seconds (max. time limit 300 s.). (4) Verbal ability: The Verbal Fluency Test, animal category (VFT) [19], the score is the total number of names of animals produced during 1 minute; and (5) Visuoconstructive function: Copying of the figures of Russell’s adaptation of the Visual Reproduction Test (CVRT) [20] from the Wechsler Memory Scale (WMS), the score is the number of components present in the drawings (max. 21). The presentation of tests in detail, the validity of the battery and the associations of age and sex with test performance have been described previously [18]. Furthermore, a neuropsychological battery including the Mini-Mental State Examination [21], the Benton Visual Reproduction Test [22] and the Paired Associated Learning sub-test from the WMS [23] was used to diagnose AAMI as reported earlier in detail [9].

The evaluations were carried out by a trained nurse, psychologist, or physician in the Memory Research Unit of the Department of Neurology in Kuopio University. An instructional manual was used to standardize the interview and presentation of tests.

To determine the cut-off points for neuropsychological tests appropriate for different levels of education, a subgroup of 278 healthy subjects without diseases which could potentially affect cognitive functions was identified from the total sample. The cut-offs for the TMT-A and TMT-C were calculated as the mean score plus 1 SD and for the BSRT, VFT and CVRT as the mean minus 1 SD in each of three educational subgroups of these healthy subjects: minimal education (3 years or less), elementary school education (4–6 years) and secondary school or high school education (7 years or more). Previous studies have used these same categories based on the Finnish educational programme for the subjects’ age group [18, 24]. The prevalence of AACD was calculated separately for each educational subgroup. The association of age with the prevalence of AACD was evaluated within three categories: subjects of 67–70, 71–74 or 75–78 years of age.

The data were analysed by using the SPSS-PC + V.4.0.1 software. The χ² test was used to evaluate the differences in AACD prevalence between the subgroups of the study population. The results for continuous variables are given as a mean with SD.

Results
Subjective complaints of cognitive decline in MAC-Q were found in 79.8% (320/402) of the subjects. The cut-off points for neuropsychological tests as determined in a subgroup of 278 healthy subjects (without exclusion diseases) in three different educational subgroups are presented in Table I. According to these cut-off points, a total of 107 subjects out of 402 (26.6%) fulfilled the AACD criteria. The prevalence of AACD tended to be higher in men (30.1%) than in women (24.4%) (Table II). Age-specific prevalence rates were: 25.2% in the age group 68–70 years, 30.5% in the age group 71–74 years, and 20.5% in the age group 75–78 years. The prevalence rates did not differ significantly in the various age groups. Education-specific prevalence rates varied in the three education groups, but the differences were not statistically significant. The subjects with 3 years or less of education had a prevalence rate of 14.3%, in subjects with 4–6 years of education it was 26.2%, and in subjects with 7 years or more education the prevalence rate was 29.4% (Table III).

No major differences were found in the ability of
neuropsychological tests to identify subjects with AACD. The BSRT identified 23.6% (89 out of 377 subjects completing this test), the TMT-A identified 19.9% (79/396), the TMT-C identified 23.3% (87/376), the VFT identified 19.3% (76/393) and the CVRT identified 22.5% (89/396) of the subjects as having AACD. Of those who were classified into AACD category, 60.7% (65/107) met the criteria due to one test only. Subsequently, 21.5% (23/107), 11.2% (12/107), 5.6% (6/107) and 0.9% (1/107) were classified as having AACD with two, three, four or all five tests. For those who met the criteria in one test only, this test was the BSRT in 26.2% (17/65), VFT in 21.5% (14/65), CVRT in 20.0% (13/65), TMT-C in 20.0% (13/65), and TMT-A in 12.3% (8/65) of the cases.

Discussion

In the present study, the prevalence rate for AACD in subjects aged 68–78 years was 26.6% according to the IPA criteria. Sex, age and education seemed to have some association with the prevalence of AACD, although the differences between subgroups were not significant. The prevalence was higher in men (30.1%) than in women (24.4%). The highest rate was found in the group of 71–74-year-old subjects and the lowest rate in subjects aged 75–78 years. The subgroup with only elementary education had the lowest rate and the best educated subgroup had the highest rate.

To our knowledge, this is the first study on the epidemiology of AACD using the IPA criteria. However, some studies have reported data concerning the epidemiology of a related concept, AAMI. The prevalence of AAMI reported in previous studies has been higher than the prevalence of AACD found in the present study. In our own study, the prevalence of AAMI was 38.4% [9]. A study by Lane and Snowdon [7] reported a 34.9% prevalence rate for AAMI. In a recent Spanish study [25] the prevalence was much lower: 7.1%. However, the definition of AAMI in the latter study was different, resembling the definition of MCD for which also a low prevalence rate, 4%, was recently reported [26]. Considering AAMI, some researchers have estimated that most people over 50 are affected to some degree [27]. It has been proposed that AAMI might be an intermediary state in the continuum from normal ageing to Alzheimer's disease [28]. However, the condition has been suggested to be rather stable [29] and in a population-based follow-up study it was shown to identify a very heterogeneous subject group with only very slightly elevated incidence of dementia [30]. Because of this markedly lower prevalence rate, AACD might identify a more homogeneous group of elderly individuals who have a higher risk of developing dementia. However, this has to be confirmed by follow-up studies with AACD subjects.

The finding of the present study that AACD is more frequent in men (30.1%) than in women (24.4%) is in accordance with a previous study of AAMI prevalence which also reported higher rates in men than in women.

Table I. The education-specific scores, mean (SD), in criterion tests in a healthy subgroup (n = 278) of the study population and cut-off points for AACD classification

<table>
<thead>
<tr>
<th>Test</th>
<th>Education in years</th>
<th>0–3 (n = 12)</th>
<th>4–6 (n = 138)</th>
<th>7 or more (n = 126)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSRT</td>
<td></td>
<td>28.5 (6.3)</td>
<td>32.6 (7.6)</td>
<td>35.6 (8.4)</td>
</tr>
<tr>
<td>Cut-off</td>
<td></td>
<td>22</td>
<td>25</td>
<td>27</td>
</tr>
<tr>
<td>TMT-A</td>
<td></td>
<td>109.3 (37.4)</td>
<td>82.0 (31.5)</td>
<td>63.0 (26.9)</td>
</tr>
<tr>
<td>Cut-off</td>
<td></td>
<td>147</td>
<td>114</td>
<td>90</td>
</tr>
<tr>
<td>TMT-C</td>
<td></td>
<td>263.7 (62.1)</td>
<td>232.8 (72.0)</td>
<td>168.9 (79.0)</td>
</tr>
<tr>
<td>Cut-off</td>
<td></td>
<td>300</td>
<td>300</td>
<td>248</td>
</tr>
<tr>
<td>VFT</td>
<td></td>
<td>15.3 (4.4)</td>
<td>16.3 (5.1)</td>
<td>19.4 (5.6)</td>
</tr>
<tr>
<td>Cut-off</td>
<td></td>
<td>11</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>CVRT</td>
<td></td>
<td>14.2 (3.4)</td>
<td>16.3 (2.4)</td>
<td>17.4 (2.3)</td>
</tr>
<tr>
<td>Cut-off</td>
<td></td>
<td>11</td>
<td>14</td>
<td>15</td>
</tr>
</tbody>
</table>

Table II. Age- and sex-specific prevalence rates for AACD according to the International Psychogeriatric Association working party criteria in the study population

<table>
<thead>
<tr>
<th>Age group</th>
<th>Number</th>
<th>Rate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td></td>
<td></td>
</tr>
<tr>
<td>68–70</td>
<td>21/75</td>
<td>28.0</td>
</tr>
<tr>
<td>71–74</td>
<td>21/59</td>
<td>35.6</td>
</tr>
<tr>
<td>75–78</td>
<td>5/22</td>
<td>22.7</td>
</tr>
<tr>
<td>Total</td>
<td>47/156</td>
<td>30.1</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>68–70</td>
<td>20/88</td>
<td>22.7</td>
</tr>
<tr>
<td>71–74</td>
<td>23/92</td>
<td>27.2</td>
</tr>
<tr>
<td>75–78</td>
<td>13/66</td>
<td>22.7</td>
</tr>
<tr>
<td>Total</td>
<td>60/246</td>
<td>24.4</td>
</tr>
<tr>
<td>Combined</td>
<td></td>
<td></td>
</tr>
<tr>
<td>68–70</td>
<td>41/63</td>
<td>25.2</td>
</tr>
<tr>
<td>71–74</td>
<td>46/151</td>
<td>30.5</td>
</tr>
<tr>
<td>75–78</td>
<td>20/98</td>
<td>20.5</td>
</tr>
<tr>
<td>Total</td>
<td>107/402</td>
<td>26.6</td>
</tr>
</tbody>
</table>

Table III. Education-specific prevalence rates for AACD according to the International Psychogeriatric Association working party criteria in the study population

<table>
<thead>
<tr>
<th>Education in years</th>
<th>Number</th>
<th>Rate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–3</td>
<td>4/28</td>
<td>14.3</td>
</tr>
<tr>
<td>4–6</td>
<td>55/210</td>
<td>26.2</td>
</tr>
<tr>
<td>7 or more</td>
<td>48/163</td>
<td>29.4</td>
</tr>
<tr>
<td>Total</td>
<td>107/402</td>
<td>26.6</td>
</tr>
</tbody>
</table>

in 20.0% (13/65), TMT-C in 20.0% (13/65), and TMT-A in 12.3% (8/65) of the cases.
Complaints of cognitive decline in this study is more likely to be exaggerated than understated, though their own age. Thus, the frequency of subjective past, instead of some other standard, such as people of their present memory with their own memory in the identified subjects is that it asks the subjects to compare MAC-Q which undoubtedly increases the number of frequently complain [3]. Another characteristic of the cognitive domain about which elderly subjects most frequently report a deterioration when assessed with the MAC-Q. The subjective complaints were proposed by the IPA do not include any age restrictions, further studies are needed to provide data about the prevalence of AACD in younger and older subjects.

The individuals with more education appeared to be more frequently classified as having AACD. The subgroups divided according to education were not equal in size as the subgroup with minimal education consisted of only 28 subjects. Given the diverse duration of education which different individuals in this age group have received, the classification is logical and it has been utilized also in previous studies [18, 24]. However, owing to the small size of the subgroup with minimal education in this study, it is difficult to draw definite conclusions about any effect of education on the prevalence of AACD.

In addition to epidemiological aspects, our results elucidate the psychometric characteristics of AACD. We used a subgroup of healthy subjects from our study population to establish the education specific norms for these neuropsychological tests. In accordance with many previous studies [18, 33, 34], we observed an association of education with test performance; the cut-off score for every neuropsychological test was highest in the best educated subjects. Thus, our results emphasize the need for well adjusted norms to be used in the neuropsychological tests in studies on AACD. This is further underscored by the effect of cultural factors on psychometric tests and scales [24, 35].

The AACD criteria require that there has to be a subjective report by the individuals that their cognitive function has declined. We found almost 80% of the subjects reporting a deterioration when assessed with the MAC-Q. The subjective complaints were proposed also as a part of the AAMI diagnosis, but this has remained a controversial issue in the AAMI literature [12]. For this study, it could be confounding that the MAC-Q is restricted only to memory. However, as the IPA working party pointed out, memory may be the cognitive domain about which elderly subjects most frequently complain [3]. Another characteristic of the MAC-Q which undoubtedly increases the number of identified subjects is that it asks the subjects to compare their present memory with their own memory in the past, instead of some other standard, such as people of their own age. Thus, the frequency of subjective complaints of cognitive decline in this study is more likely to be exaggerated than understated, though complaints in other cognitive domains than memory were not surveyed. Furthermore, we need to note that in the AACD criteria reports of decline by reliable informants can be used instead of subjective complaints. In the present study, however, the reports by informants were not evaluated. In further studies involving AACD subjects, the methods for assessing such subjective or informant-based reports about cognitive decline need critical evaluation.

Each of the neuropsychological tests in the battery assigned a similar number of subjects to the AACD category. The BSRT, a memory test, was the most sensitive in classifying subjects as having AACD. When we used only one test to assess each cognitive domain, about 60% of the AACD subjects met the classification on the basis of one test only. This suggests that the number of tests in the battery is critical for the identification of AACD. We may speculate that if the number of tests was increased also the frequency of AACD cases would be elevated.

The selection of tests for the neuropsychological evaluation undoubtedly influences the prevalence of AACD. In the present study, we selected a test battery which could provide as good an overall description of cognition as possible by an easily administered brief examination. To keep the test session short, we employed only one test for each cognitive domain. However, each test employed can cover only one part of the wide spectrum of cognitive abilities. Although the VFT reflects naming skills, it gives only a limited assessment of verbal abilities. It is also related to semantic memory and attention. The CVRT is a test of visuococonstructive function but does not include spatial components. In addition to attention, TMT-A involves motor function which may obscure the results especially in elderly subjects. The TMT-C assesses effortful processing and problem-solving in a stressing situation, but like the TMT-A it is dependent also on attention and motor performance. Some other test which had no time-limiting and motor components would be better than the TMT-C to assess 'pure' problem-solving. The BSRT has been considered as a quite accurate measure of memory. The major advantage of our test battery is that all the tests are well known and widely used in both research and clinical settings.

In conclusion, the present study reports the prevalence of AACD to be lower than that of AAMI. This suggests that AACD might be better than AAMI in differentiating those who have a genuine cognitive decline that possibly justifies pharmacological intervention trials or who should be observed in follow-up studies for the development of dementia from subjects with 'normal' ageing. Therefore, AACD might also turn out to be clinically more relevant than AAMI. However, data from follow-up studies are needed before firm conclusions can be drawn about the relevance of this diagnostic category. Furthermore, this study emphasizes the need for obtaining carefully adjusted norms in psychometric tests to be used in neuropsychological assessment of elderly populations.
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**References**


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