Do employed and not employed 55 to 64-year-olds’ memory complaints relate to memory performance? A longitudinal cohort study

Published as:
Abstract

**Background:** Whether middle-aged individuals are capable of employment continuation may be limited by poor memory. Subjective memory complaints may be used to identify those at risk of poor memory. Research questions, therefore, were (i) are prevalent memory complaints associated with relevantly poor memory performance and decline in 55 to 64-year-olds; (ii) are incident memory complaints associated with relevant memory decline; and (iii) do these associations differ between employed and not employed individuals?

**Methods:** Participants of the Longitudinal Aging Study Amsterdam (LASA) were examined. Data were weighted by sex, age and region. To examine the association of prevalent memory complaints with relevantly poor learning ability (n = 903) and delayed recall (n = 897; both assessed with the Auditory Verbal Learning Test), subnormal (≤ mean -1 SD) and impaired (≤ mean -1.5 SD) memory performance were defined. To examine the association of prevalent and incident memory complaints with relevant decline after 3 years in learning ability (n = 774 and 611, respectively) and delayed recall (n = 768 and 603, respectively), above normal (≤ mean -1 SD) and clinically relevant (≤ mean -1.5 SD) memory decline were investigated. Logistic regression analyses were applied.

**Results:** Adjusted for gender, education and age, individuals with memory complaints more often had impaired delayed recall and clinically relevant decline in learning ability. Incident memory complaints were borderline significantly associated with clinically relevant decline in learning in continuously employed individuals (paid job ≥ 1 h weekly), but not in continuously not employed individuals.

**Conclusion:** Memory complaints may identify 55 to 64-year-olds at risk of memory impairment and decline. Our results provide hypotheses about the association between memory complaints and decline in employed 55 to 64-year-olds.
Introduction

Retirement policies in many European countries are focused on decreasing the number of early retirees. Whether middle-aged individuals still eligible for employment are able to work may in part be determined by memory performance. Memory performance is thought to influence work ability in middle-aged workers (Ilmarinen 2001). Indeed, subjective memory deterioration has been reported by middle-aged workers to be one of the most important problems in performing their job (Koolhaas et al 2012). Subjective memory complaints assessed by a single question (i.e. do you have complaints about your memory?) may be a simple way of determining those at risk of poor memory performance. However, whether subjective memory problems actually reflect poor memory performance has not often been examined in middle-aged individuals who, based on their age, are still eligible for employment.

There is evidence that subjective memory complaints in middle-aged and older individuals are associated with poor cognitive performance (Wang et al 2000; Mol et al 2006; Pearman & Storandt 2004) and that they may be an early indication of future cognitive decline and dementia in older persons. (Geerlings et al 1999; Jonger, Geerlings & Schmand 2000; Dik et al 2001; Reid & MacLullich 2006) Specifically in 60-64-year-olds, memory complaints also revealed to be associated with cognitive performance. (Jorm et al 2004) In addition, memory complaints in 59-71-year-olds predicted cognitive decline. (Dufouil, Fuhrer & Alperovitch 2005) To determine whether these memory complaints have been developed recently, incident memory complaints need to be examined. To our knowledge, no studies examined this before in exclusively middle-aged individuals. We will focus on the association between incident memory complaints and cognitive decline.

It can be argued that compared with not employed age peers, middle-aged workers notice poor or deteriorating memory performance sooner because their job requires good memory capacities and, therefore, more often report memory complaints. Middle-aged individuals have not only ascribed their memory complaints to poor memory performance but also to stress and tension (Commissaris et al 1996) and even stress and multitasking specifically resulting from their job (Vestergren & Nilsson 2010). One study demonstrated that perceived stress levels, although not specifically work stress, were associated with memory complaints (Potter, Hartman & Ward 2009). Still, whether memory complaints are better indicators of memory performance among employed compared with not employed individuals is unclear.

The goal of the current study is to examine whether memory complaints are associated with poor memory performance and decline in both employed and
not employed 55 to 64-year-olds participation in a population-based cohort study. First, to confirm previous research, it is examined whether prevalent memory complaints are associated with relevantly poor memory performance and predict relevant memory decline. Our second research question, which adds to the current literature, was aimed at the association between incident memory complaints and relevant memory decline. Third, we examined whether the association of memory complaints with memory performance and decline differed between employed and not employed individuals.

**Methods**

**Study sample**
Data from the Longitudinal Aging Study Amsterdam (LASA) were used. The LASA study is a continuing population-based cohort study that focuses on cognitive, social, emotional and physical functioning in later life. A random sample of 55 to 85-year-olds, stratified by age and sex according to expected 5-year mortality, was drawn from population registries in eleven municipalities in three geographical regions of The Netherlands. The sampling, data collection procedures and non-response have been described in detail elsewhere (Huisman et al 2011). In total, 3107 predominantly Caucasian (>99%) respondents were enrolled in the baseline examination in 1992–93. Follow-up measurements took place in 1995–96, 1998–99, 2001–02, 2005–06 and 2008–09. An additional sample of 1002 respondents aged 55–64 years was drawn in 2002–03 with the same sampling frame as the original cohort. Follow-up measurements took place in 2005–06 and 2008–09.

In the current study, data from wave 2002–03 and 2005–06 were considered baseline and follow-up data, respectively. Respondents with missing data on memory complaints, employment status and memory performance were excluded. Details on response and inclusion of respondents are shown in Appendix 1 (Flow charts A1 and A2). Samples of different sizes were studied, depending on the examined association, to maximize power. To examine the association of prevalent memory complaints with poor learning ability, delayed recall, decline in learning ability and delayed recall, study samples were used of n = 897 (weighted according to age, sex and region n = 903), n = 891 (weighted n = 897), n = 762 (weighted n = 774) and n = 756 (weighted n = 768), respectively. Respondents excluded because of missing follow-up data (n = 235) from the study sample used to examine the association between prevalent memory complaints and decline in learning ability, significantly more often were not employed, lower educated and had lower mean baseline learning ability. Respondents excluded because of missing
follow-up data (n = 241) from the study sample used to examine the association between prevalent memory complaints and decline in delayed recall, significantly more often were not employed, lower educated and had lower mean baseline delayed recall. No differences were found for gender or age.

To examine the association between incident memory complaints (i.e. no complaints at baseline and complaints at follow-up) and memory decline, respondents with baseline prevalent memory complaints (n = 213) were additionally excluded. Respondents excluded because of missing follow-up data (n = 180) were significantly more often not employed and had lower mean baseline learning ability compared with those included to examine the association between incident memory complaints and decline in learning ability (n = 604; weighted n = 611). Compared with respondents included to examine the association between incident memory complaints and change in delayed recall (n = 598; weighted n = 603), respondents excluded from this sample because of missing data (n = 186) were also significantly more often not employed and had lower mean baseline delayed recall. No differences were found for gender, age or level of education.

**Dependent and independent variables**

**Demographic factors** - Age and gender were examined. Level of education was examined as a continuous variable, ranging from 1 (elementary school not completed) through 9 (university education).

**Memory complaints** - The presence of memory complaints was assessed using the question ‘Do you have complaints about your memory?’ (Yes/No). This question has been shown to be predictive of cognitive decline in 62 to 85-year-olds (Dik et al 2001).

**Memory performance** - Memory performance was assessed by a Dutch version of the Auditory Verbal Learning Test (Rey 1964). In the LASA study, the test is limited to three (instead of five) trials to lighten the burden for respondents (Comijs et al 2009). During each trial, respondents are asked to remember as many words as possible of 15 words. The number of words learned by the respondent on all three trials is defined as learning ability (range: 0–45). After approximately 20 min, the respondent was asked to recall as many words as possible to measure delayed recall (range: 0–15).

In the current study, relevantly poor memory performance and relevant memory decline were examined to provide an indication of functioning in society. To determine relevantly poor memory performance and relevant memory decline, standard deviations (SDs) are often utilized in clinical practise. No consensus exists. Examiners may interpret a SD of 1 or more below the mean of a normative sample as ‘probably impaired’ (Hannay & Lezak 2004). According to Hendriks et al (2006)
and Jungwirth et al (2004) a score of 1.5 SD below the mean should be considered as impaired. Therefore, we chose to operationalize poor memory performance in two ways (i) scores ≥ 1 SD below the mean of the whole group were defined as subnormal and (ii) scores ≥ 1.5 SD below the mean were defined as impaired (Hendriks et al 2006). In addition, examiners may consider a change of 1, 1.5 or 2 SD lower than the previous measured score as indicative of impaired performance (Hannay & Lezak 2004). We chose to operationalize relevant memory decline in two ways (i) change scores ≥ 1 SD above the mean change (i.e. a larger decrease) were defined as above normal decline and (ii) change scores ≥ 1.5 SD above the mean change were defined as clinically relevant decline.

The cut-offs for subnormal memory performance, memory impairment, above normal and clinically relevant decline are shown in Appendix 2 (table A1). For the determination of these cut-offs only, scores of ≥ 3 SD below or above mean memory performance and mean change in memory performance were considered to be outliers for that measure and were excluded as such, so any possible measurement errors do not skew the means.

Employment status - Employment status was categorized as not employed (0) and employed (1). Respondents were considered employed if they had a paid job of at least 1 h weekly and not employed if they did not have a paid job of at least 1 h weekly. An additional employment status variable was computed, which was categorized as continuously employed (i.e. employed at baseline and follow-up; 0) and continuously not employed (i.e. not employed at both baseline and follow-up; 1). Few respondents became employed, that is, they were not employed at baseline and employed at follow-up (Appendix 1), and were excluded. Of respondents that became not employed, that is, they were employed at baseline and not employed at follow-up (Appendix 1), ≤8 experienced both (incident) memory complaints and relevant memory decline (not tabulated). A sensitivity analysis revealed no significant differences regarding baseline learning ability and delayed recall between continuously employed, continuously not employed, respondents that became employed and respondents that became not employed.

Statistical analyses
For all further analyses in this study, outliers on memory measures were included. In addition, all analyses were weighted by sex, age and region according to the Dutch population as measured on the first of January 2003 by the Statistics Netherlands.

By applying the $\chi^2$ test for categorical variables and the independent-samples t-test for continuous variables, it was examined whether differences exist between respondents with and without (incident) memory complaints.
Logistic regression analyses were applied to examine whether the association between memory complaints and (decline in) memory performance was significant ($P < 0.05$). Whether employment status was an effect modifier was studied by adding interaction terms between baseline memory complaints and employment status in the adjusted models. If an interaction term was borderline significant ($P < 0.10$), stratified results were shown according to Figueiras and colleagues (1998).

**Results**

**Descriptive information**
Table 1 shows that 21.3% of 55 to 64-year-olds had memory complaints at baseline. Age, gender, level of education and employment status did not differ significantly between individuals with and without memory complaints. Individuals that reported memory complaints had significantly lower mean delayed recall. No other significant differences were found.

**Table 1. Descriptive information for 55-64-year-olds with compared with without prevalent or incident memory complaints**

<table>
<thead>
<tr>
<th></th>
<th>Total, n</th>
<th>No</th>
<th>Yes</th>
<th>p</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td><strong>Prevalent memory complaints, n (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline (2002-03) age, mean (SD)</td>
<td>910</td>
<td>60.1 (2.8)</td>
<td>60.5 (3.1)</td>
<td>.091</td>
</tr>
<tr>
<td>Male, n(%) (vs. Female)</td>
<td>910</td>
<td>350 (48.9)</td>
<td>83 (43.0)</td>
<td>.147</td>
</tr>
<tr>
<td>Level of education, mean (SD)</td>
<td>910</td>
<td>4.3 (2.1)</td>
<td>4.3 (1.9)</td>
<td>.950</td>
</tr>
<tr>
<td>Employed, n (%) (vs. not)</td>
<td>910</td>
<td>303 (42.3)</td>
<td>71 (36.6)</td>
<td>.151</td>
</tr>
<tr>
<td>Learning ability, mean (SD)</td>
<td>903</td>
<td>20.8 (5.4)</td>
<td>20.0 (5.5)</td>
<td>.085</td>
</tr>
<tr>
<td>Delayed recall, mean (SD)</td>
<td>897</td>
<td>6.4 (2.7)</td>
<td>5.9 (2.6)</td>
<td>.020</td>
</tr>
<tr>
<td>Learning ability, mean change (SD)</td>
<td>770</td>
<td>2.1 (4.9)</td>
<td>1.8 (5.7)</td>
<td>.431</td>
</tr>
<tr>
<td>Delayed recall, mean change (SD)</td>
<td>757</td>
<td>0.7 (2.6)</td>
<td>0.4 (2.8)</td>
<td>.213</td>
</tr>
<tr>
<td><strong>Incident memory complaints, n (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline (2002-03) age, mean (SD)</td>
<td>614</td>
<td>59.9 (2.7)</td>
<td>60.4 (2.8)</td>
<td>.128</td>
</tr>
<tr>
<td>Male, n(%) (vs. Female)</td>
<td>614</td>
<td>260 (50.5)</td>
<td>45 (45.5)</td>
<td>.359</td>
</tr>
<tr>
<td>Level of education, mean (SD)</td>
<td>614</td>
<td>4.4 (2.1)</td>
<td>4.4 (2.0)</td>
<td>.756</td>
</tr>
<tr>
<td>Continuously employed, n (%) (vs not)</td>
<td>477</td>
<td>140 (35.4)</td>
<td>28 (34.1)</td>
<td>.823</td>
</tr>
<tr>
<td>Learning ability, mean change (SD)</td>
<td>611</td>
<td>2.3 (5.0)</td>
<td>1.5 (5.0)</td>
<td>.171</td>
</tr>
<tr>
<td>Delayed recall, mean change (SD)</td>
<td>603</td>
<td>0.6 (2.9)</td>
<td>0.5 (2.5)</td>
<td>.756</td>
</tr>
</tbody>
</table>

Note: Data are weighted according to the Dutch population.
a: The numbers may not add up to 100% due to missing values.
b: Numbers may differ slightly from numbers in flowcharts as a result of the used weights.
c: Respondents who became not employed or employed were excluded.
After 3 years, incident memory complaints (i.e. no memory complaints at baseline and memory complaints at follow-up) were found in 16.1% of 55 to 64-year-olds (Table 1). No differences were found between individuals with and without incident memory complaints regarding baseline age, gender, level of education, employment status and mean learning ability and delayed recall.

Figure 1 Weighted memory performance and memory decline in 55 to 64-year-olds. MC = Memory complaints. Respondents with prevalent memory complaints significantly more often had impaired delayed recall (*p≤0.006) and clinically relevant decline in learning ability (**p≤0.012) compared with those without memory complaints.
Figure 1 shows that individuals with memory complaints significantly more often had impaired delayed recall (10.5%) compared with those without memory complaints (5.1%). In addition, those with prevalent memory complaints at baseline more often had clinically relevant decline in learning ability after 3 years (18.9%) compared with age peers without memory complaints (11.5%). No additional significant differences were found between individuals with and without prevalent or incident memory complaints regarding learning ability and delayed recall performance and decline.

**Association of prevalent memory complaints with memory performance and decline**

Individuals with prevalent memory complaints were significantly more likely to have impaired delayed recall when adjusted for gender, age and level of education (Table 2). In addition, prevalent memory complaints significantly predicted decline in learning ability after 3 years, adjusted for age, gender and education. No additional associations were found between prevalent memory complaints and memory performance and decline. Employment status did not prove to be an effect modifier in these models.

**Table 2.** Association between prevalent memory complaints and (decline in) memory performance.

<table>
<thead>
<tr>
<th>Memory performance</th>
<th>Total, n</th>
<th>Memory complaints (vs no)</th>
<th>OR</th>
<th>CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Learning ability</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subnormal performance (vs not)³</td>
<td>903</td>
<td>1.40</td>
<td>0.90-2.17</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Impairment (vs not)²</td>
<td>903</td>
<td>1.53</td>
<td>0.89-2.64</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Delayed recall</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subnormal performance (vs not)³</td>
<td>897</td>
<td>1.55</td>
<td>0.98-2.44</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Impairment (vs not)⁴</td>
<td>897</td>
<td>2.50</td>
<td>1.39-4.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Decline in memory performance</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Learning ability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Above-normal decline (vs not)⁵</td>
<td>774</td>
<td>1.35</td>
<td>0.87-2.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clinically relevant decline (vs not)⁶</td>
<td>775</td>
<td>1.84</td>
<td>1.15-2.94</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Delayed recall</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Above-normal decline (vs not)⁷</td>
<td>768</td>
<td>1.37</td>
<td>0.92-2.06</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clinically relevant decline (vs not)⁸</td>
<td>767</td>
<td>1.60</td>
<td>0.87-2.95</td>
</tr>
</tbody>
</table>

Note: analyses were adjusted for gender, age and level of education. Data are weighted according to the Dutch population. To examine effect modification, interaction terms between employment status and memory complaints (a: p=.119, b: p=.146, c: p=.811, d: p=.184) and between employment status (i.e. 'continuously employed' versus 'continuously not employed') and memory complaints were added (e: p=.532, f: p=.485, g: p=.138, h: p=.101). 

i: Numbers may differ slightly from numbers in flowcharts as a result of the used weights.
Association of incident memory complaints with memory decline

No association was found between incident memory complaints and memory decline (Table 3). In the model examining the association with clinically relevant decline in learning ability, the interaction term with employment status proved to be significant. After stratification, continuously employed individuals with incident memory complaints showed to be more likely to have clinically relevant decline, although this association was only borderline significantly. No significant association was found for continuously not employed individuals.

Table 3. Association between incident memory complaints and decline in memory performance.

<table>
<thead>
<tr>
<th>Incident memory complaints (vs no)</th>
<th>Total, n</th>
<th>OR</th>
<th>CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Learning ability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above-normal decline (vs not)</td>
<td>611</td>
<td>1.60</td>
<td>0.94-2.72</td>
<td>.083</td>
</tr>
<tr>
<td>Clinically relevant decline (vs not)</td>
<td>611</td>
<td>1.36</td>
<td>.64-2.89</td>
<td>.426</td>
</tr>
<tr>
<td>Continuously employed individuals</td>
<td>167</td>
<td>3.38</td>
<td>0.88-13.00</td>
<td>.075</td>
</tr>
<tr>
<td>Continuously not employed individuals</td>
<td>308</td>
<td>0.47</td>
<td>0.09-2.29</td>
<td>.345</td>
</tr>
<tr>
<td><strong>Delayed recall</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above-normal decline (vs not)</td>
<td>603</td>
<td>0.85</td>
<td>0.48-1.50</td>
<td>.582</td>
</tr>
<tr>
<td>Clinically relevant decline (vs not)</td>
<td>603</td>
<td>0.88</td>
<td>0.34-2.26</td>
<td>.791</td>
</tr>
</tbody>
</table>

Note: Analyses were adjusted for gender, age and level of education. Data are weighted according to the Dutch population. To examine effect modification, interaction terms between employment status (i.e. ‘continuously employed’ versus ‘continuously not employed’) and memory complaints were added (a: p=.902, b: p=.062, c: p=.841, d: p=.720).

e: Numbers may differ slightly from numbers in flowcharts as a result of the used weights.

Discussion

Many European countries designed policies aimed at increasing the number of middle-aged workers. However, poor memory in 55 to 64-year-olds might limit their possibilities for continuation of employment. Our goal was to determine whether memory complaints assessed by a single question may identify those at risk of poor memory performance and decline in both employed and not employed 55 to 64-year-olds. First, our results showed that individuals with prevalent memory complaints were more likely to have concurrent memory impairment and subsequent clinically relevant memory decline during a period of 3 years. Prevalent memory complaints in this age group could, therefore, point to a serious memory
impairment and predict future clinically relevant memory decline. These findings are in line with previous studies (Jorm et al 2004; Dufouil, Fuhrer & Alperovitch 2005).

Note that the majority of 55 to 64-year-olds with memory complaints have normal or subnormal memory performance. In these individuals, memory complaints are apparently associated with other characteristics, such as physical diseases (Aarts et al 2010; Bunch et al 2004; Comijs et al 2002) and mental problems (Jorm et al 2004), which are known to lead to drop-out from the workforce (Van den Berg, Elders & Burdorf 2010). Therefore, it can be argued that, depending on the cause, individuals with memory complaints might be better able to continue employment if memory training, cognitive strategy training and alleviations in physical and mental demands of employment are facilitated.

Second, it was determined whether incident memory complaints that developed during the past 3 years could identify middle-aged individuals who underwent a clinically relevant memory decline over that same period. For this purpose, the association between incident memory complaints and relevant memory decline was examined, which adds to the current literature on memory complaints in 55 to 64-year-olds. No such association was found. Because of disparate sample sizes and time sequence of independent and dependent measures, caution is needed when comparing the results of prevalent and incident memory complaints. Still, it is noteworthy that prevalent, but not incident, memory complaints were associated with memory performance and decline. Although it is unknown from our results, prevalent memory complaints may be persistent, and incident memory complaints are not (yet). It can, therefore, be argued that persistent compared with transient memory complaints are more likely to be associated with objective memory performance and decline. Also, it is thought that individuals notice memory deterioration when objective memory tests are not yet able to provide proof of relevant decline (Jungwirth et al 2004). Thus, incident memory complaints might be ascribed to only minor, and possibly irrelevant, memory deterioration. It should be noted that it is unknown whether incident memory complaints arose before memory decline or vice versa. Future studies should, therefore, examine whether incident memory complaints predict relevant memory decline for a longer period and/or whether memory decline might have preceded incident memory complaints in 55 to 64-year-olds.

With the third research question, we aimed to examine whether memory complaints are better indicators of memory performance or decline among employed compared with not employed individuals. Prevalent memory complaints did not seem to be a better indicator of memory performance or future memory
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decline in employed compared with not employed individuals. Nevertheless, our results provide some evidence that employed individuals notice clinically relevant memory decline better, whereas not employed are not, although caution is needed. Employed 55 to 64-year-olds with incident memory complaints were only borderline significantly more likely to have clinically relevant memory decline, whereas no association was found for not employed age peers. To confirm this result, our analyses need to be replicated using larger study samples. It may be hypothesized that employed notice clinically relevant memory decline simply because their job requires good memory capacities as has been discussed by other researchers (Aarts et al 2010; Mol et al 2009). In addition, previous studies have found increased stress levels to be associated with memory complaints (Commissaris et al 1996; Vester gren & Nilsson 2010; Potter et al 2009). Therefore, an additional explanation may be that memory functions less as a result of stress because of employment, as (too much) stress is thought to disturb memory processes (Lupien et al 2007). To confirm these hypotheses, research is needed aimed at the influence of jobs with high stress levels, such as jobs with high-time pressure, high-job requirements, low rewards and low support (Siegrist 1996; Karasek & Theorell 1990), as well as jobs with high cognitive demands.

Strength of our study was that we focused on the association between memory complaints and memory performance in middle-aged individuals and that we were able to examine the influence of employment status. In addition, although studies have shown that memory complaints may both reflect poor cognitive performance (Jorm et al 2004) and predict cognitive decline (Dufouil, Fuhrer & Alperovitch 2005), no studies that we know of have reported on the relationship between incident memory complaints and memory decline and the role of job status in this age group.

A few limitations of our study should be mentioned. First, the number of individuals who performed subnormal or declined above normal on a cognitive test was small; therefore, our findings need to be replicated in larger samples. Second, because of attrition, the association between prevalent as well as incident memory complaints and memory decline might have been underestimated, as respondents that were lost to follow-up more often showed a lower mean level of memory performance. Third, the current study sought to investigate memory complaints by using a single question. Possibly, we found little association with poor memory performance and relevant memory decline because only certain types of complaints are related to memory performance, such as finding one’s way around familiar streets (Amariglio et al 2011). Still, the single question may be more feasible to use in future studies and prevention programs. Fourth, it is unknown whether memory
complaints are persistent or transient, which may have biased our results. Research is needed that examines whether persistent memory complaints are indeed better indicators of objective memory than transient memory complaints. Finally, lenient cut-offs (i.e. 1 and 1.5 SDs instead of 2 SDs) were chosen. Although this may result in overestimation of memory dysfunctioning, it decreases the number of false-negative judgments (i.e. individuals with impaired performance judged as functioning normally) (Hannay & Lezak 2004).

Our main aim was to examine whether memory complaints were associated with memory performance and decline. Our results confirmed previous studies (Jorm et al 2004; Dufouil, Fuhrer & Alperovitch 2005) that prevalent memory complaints in middle-aged individuals could point to a serious memory impairment and predict clinically relevant memory decline. Against the background of policies aimed at decreasing the number of early retirees, prevalent memory complaints reported by 55 to 64-year-olds may be a useful tool to identify those at risk of poor memory performance and relevant memory decline. In addition, our results suggest that only employed individuals who developed memory complaints in the past 3 years are likely to have had a clinically relevant memory decline during that same period. More research is needed to confirm whether middle-aged workers may notice clinically relevant memory decline sooner than not employed middle-aged individuals.

Funding and acknowledgements

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CHAPTER 3

References


DO EMPLOYED AND NOT EMPLOYED 55 TO 64-YEAR-OLDS’ MEMORY COMPLAINTS RELATE TO MEMORY PERFORMANCE? A LONGITUDINAL COHORT STUDY


Appendix 1

Flowcharts describing the response and inclusion of respondents.

**Flowchart A1.** Response and inclusion of respondents used to examine the association between prevalent memory complaints and baseline memory performance and memory decline at follow-up.

- **Baseline missing data (n=5):**
  - 4 memory complaints
  - 1 employment status

- **Missing learning ability & delayed recall data n=92**

- **n=905 Unweighted (n=910 Weighted)**

- **Follow-up missing data:**
  - 137 memory complaints
  - 20 employment status
  - 70 change in learning ability & delayed recall

- **n=770 Unweighted (n=781 Weighted)**

- **n=756 Unweighted (n=768 Weighted)**

- **n=762 Unweighted (n=774 Weighted)**

- **n=8 missing data change in delayed recall**

- **n=8 missing data change in learning ability**

- **n=14 missing data change in delayed recall**

- **n=14 missing data change in learning ability**

- **n=120 Became not employed**
  - n=33 Became employed

- **n=119 Became not employed**
  - n=32 Became employed

- **No missing delayed recall and employment data: n=605 Unweighted (n=607 Weighted)**
  - n=205 continuously employed and n=402 continuously not employed

- **No missing learning ability and employment data: n=609 Unweighted (n=612 Weighted)**
  - n=207 continuously employed and n=405 continuously not employed
Flowchart A2. Response and inclusion of respondents to examine the association between incident memory complaints and memory decline between baseline and follow-up.
### Appendix 2

Table A1. Cut-offs that determine subnormal and impaired memory performance and above-normal and clinically relevant memory decline.

<table>
<thead>
<tr>
<th>Measures of memory performance and change</th>
<th>Total study sample</th>
<th>Study sample excluding outliers</th>
<th>Subnormal performance (mean-1SD)</th>
<th>Impairment (mean-1.5SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
<td>Mean (SD)</td>
<td>n</td>
<td>Range</td>
</tr>
<tr>
<td><strong>Prevalent memory complaints</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning ability</td>
<td>0 to  37</td>
<td>20.6 (5.4)</td>
<td>903</td>
<td>6 to 35(^{a})</td>
</tr>
<tr>
<td>Delayed recall</td>
<td>0 to  15</td>
<td>6.3 (2.7)</td>
<td>897</td>
<td>0 to 14(^{a})</td>
</tr>
<tr>
<td>Change in learning ability</td>
<td>-15 to 19</td>
<td>2.09 (5.2)</td>
<td>774</td>
<td>-13 to 17(^{b})</td>
</tr>
<tr>
<td>Change in delayed recall</td>
<td>-12 to  9</td>
<td>0.51 (2.9)</td>
<td>768</td>
<td>-7 to 9(^{b})</td>
</tr>
<tr>
<td><strong>Incident memory complaints</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in learning ability</td>
<td>-14 to 19</td>
<td>2.17 (5.0)</td>
<td>611</td>
<td>-12 to 17(^{b})</td>
</tr>
<tr>
<td>Change in delayed recall</td>
<td>-12 to  9</td>
<td>0.54 (2.9)</td>
<td>603</td>
<td>-7 to 9(^{b})</td>
</tr>
</tbody>
</table>

Note: Data are weighted according to the Dutch population.

\(^{a}\): Outliers of baseline scores were excluded.

\(^{b}\): Outliers of both the change measure as well as the scores at baseline and follow-up were excluded.