Sex differences on MoCA and MMSE scores and the value of self-report of memory problems among community dwelling people 70 years and above - The HUNT study

Knut Engedal (1,2), Linda Gjøra (1,3), Thea Bredholt (1), Pernille Thingstad (4,5), Gro Gujord Tangen (1,2), Linda Ernstsen L (6), Geir Selbæk (1,2,7).

1.Norwegian National Advisory Unit on Aging and Health, Vestfold Hospital Trust, Tønsberg, Norway

2. Department of Geriatric Medicine, Oslo University Hospital, Oslo, Norway

3. Department of Psychiatry, Levanger Hospital, Nord-Trøndelag Hospital Trust, Levanger, Norway

4. Department of Neuromedicine and Movement Science, Norwegian University of Science and Technology, Trondheim, Norway

5. Department of Health and Social Services, City of Trondheim, Trondheim, Norway

6. Department of Public Health and Nursing, Norwegian University of Science and Technology, Trondheim, Norway

7. Faculty of Medicine, University of Oslo, Oslo, Norway.

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Corresponding author: Knut Engedal, Norwegian National Advisory Unit on Aging and Health, Vestfold Hospital Trust, P.O. 2136, 3103 Tønsberg, Norway; e-mail: knut.engedal@aldringoghelse.no, phone +47 91590433

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Abstract

Introduction

Aims: The aims were to examine if total and item scores on the Montreal Cognitive Assessment (MoCA) and the Mini Mental Examination (MMSE) and self -reported of memory problems differed between older women and men, and if self-reported memory problems were associated with scores on the two tests.

Methods

We included 309 home-dwelling people aged 70 years and above, 155 women, mean age 75.6 (SD 4.1) years and 154 men, mean age 76.0 (SD 4.6) years. They were examined with MoCA and MMSE and answered two questions: "have you experienced any memory problems" and "have you experienced significant memory problems the last five years".

Results

The participants scored significantly higher on MMSE (women 28.0 (1.8), men 28.4 (1.4)) than MoCA (women 24.6 (3.3), men 24.3 (3.1)). Spearman's rho was 0.36 between the tests. Women scored significantly higher than men on delayed recall of MoCA (3.0 (1.6) vs 2.4 (1.6)), whereas men scored significantly higher on visuoconstruction (3.8 (1.2) vs. 3.5 (1.0)) and serial subtraction on MoCA (2.7 (0.6) vs 2.5 (0.8)) and serial seven on MMSE (4.5 (0.8) vs 4.1 (1.1)). Multivariate linear regression analyses revealed that female sex, younger age and higher education were associated with higher score on MoCA, whereas age and education were associated with higher score on MMSE. About half of the participants (no sex difference) had experienced significant memory problems the last five years and those had significantly lower scores on both tests.

Conclusions

MoCA score was associated with sex, age and education, whereas sex did not influence on MMSE score. The question "have you experienced significant memory problems the last five years" may be useful to evaluate older people's cognition.

Introduction

With a growing number of older adults worldwide it is estimated that in 2050 more than 130 million people will have dementia [1, 2]. In most cases the first sign of dementia is a decline in cognition, most commonly a decline in episodic memory from a previous level. Today, the general approach is to identify older people with such a decline and follow them over years, because 20% to 50% of people with mild cognitive impairment (MCI) will develop dementia [3-5)]. As no curative treatment exists for any brain disorders leading to dementia, screening is not recommended. However, simple, cheap and valid case-detection tools to identify persons with high risk of developing dementia are requested so that these people can make plans for the future.

During more than 40 years the Mini Mental State Examination (MMSE) has been the most used instrument to detect cognitive impairment in older adults, and in Norway a validated version of MMSE has been in use the last 30 years [6, 7]. Depending on age (higher age is associated with lower score), educational level (higher education is associated with higher score) and cultural background, a score below 24, or 25 or even 26 has been recommended for the definition of cognitive impairment of significant degree [8, 9]. Using one of these cut-offs, the MMSE have been found to be poor in detecting persons with MCI, but valid to detect persons with dementia [10, 11)] For this reason, and in addition that the MMSE is under copyright restriction, new case-detection tools have been developed and validated [12]. One instrument that has gained popularity is the Montreal Cognitive Assessment (MoCA) that was developed mainly as an instrument to detect MCI [13]. The general view is that a score below 26 on MoCA, adjusted to 25 among people with education of 12 years and below, will identify people with MCI. Adjustment for age could also be considered [9, 13-15]. A substantial number of studies conducted across the world, included in the systematic reviews by Pinto et al. and Driscoll et al., have shown that MoCA is superior to MMSE in detecting MCI, but not dementia [16, 17]. However, one should bear in mind that most of these studies used the Mayo criteria for the diagnosis of MCI [18]. One of the Mayo criteria is that a diagnosis of MCI can only be made when a person has a score of -1.5 standard deviation below what is normal for the person's age and education. If a score on MoCA or MMSE correlate highly with the cognitive test used to diagnose MCI this could lead to a circularity problem. To avoid circularity problems a cognitive test should be used that correlate poorly with MoCA and MMSE.

The main differences between the two instruments are that the MMSE has a larger focus on verbal abilities compared to MoCA and it is easier to achieve a high score, e.g. 28-30 points on MMSE compared to MoCA [16, 18]. MoCA contains more items testing executive and visuo-constructive function and covers more cognitive domains compared to MMSE. Both instruments are scored from zero to 30, and many studies have explored how the test scores of the two tests correspond to each other [9, 15-17, 19-22.]. The main explanations for the different scores are that MoCA is more comprehensive and challenging as it is developed to detect MCI, whereas MMSE originally was developed to detect delirium and psychiatric condition among patients in specialist health care [6].

Studies comparing MMSE and MoCA have to a large degree included clinical samples, not community samples, to examine the discriminatory power of the tests to separate cognitively normal older adults from those with MCI and dementia [9, 13, 15-17, 19-22]. In these studies, adjustments have been made according to people's age and education, but not to sex [9, 13, 20-22]. A few community studies have examined whether older women and men score differently on the two tests, and whether sex influences differently on the scores of the two tests [23-27]. These studies could report sex differences, especially by use of MoCA, with higher scores among women [23-26]. One larger community study reported that older women had higher score on MMSE compared to men (27). Surprisingly few studies have examined whether sex differences can be detected using MMSE and MoCA, as it is well known since more than fifty years that women outperform men on verbal tasks and men perform better than women on spatial tasks [28, 29]. Later studies have showed that these sex differences also exist in older adults, with similar sex-associated differences seen in e.g. verbal memory tests, perhaps caused by underlying pathological mechanisms, or it could indicate that the sex differences found early in life persist by increasing age [29-33].

The association between memory complaints and significant cognitive impairment and dementia have been examined in numerous studies, but only some studies have compared self-reported cognitive complains (SCC) with scores on MMSE and MoCA among home - dwelling older people [34-42]. All these studies indicate that older adults with SCC are at higher risk of developing dementia compared to those with no complaints, although a systematic review concludes that one should not use SCC as a predictor of future development of dementia [35]. Comparison of scores on MMSE and MoCA with a single question of memory problems has been studied in clinical samples, but less in community

samples [43]. In the recent study of Wanrooji et al. it was found that a single question of memory complains was associated with recall of three words as measured by MMSE, and development of dementia after mean 6.7 years [43]. This finding needs to be replicated because if a single question could be applied as a pre-screening tool, we could better target who should be tested with MMSE or MoCA. In addition, it adds knowledge to what has been proven useful in clinical practice and research in many areas of medicine: we should listen to the patient's experience of own disease. Probably, a general question of any memory or other cognitive problems would not be useful, whereas a specific question related to duration and severity of memory problems or memory problems related to certain situations would be more sensitive. Further, it is suggested that older women more often complain about memory problems as compared to men, but we do not know whether this could be due to depression, which is more prevalent in women [44, 45]. Thus, it is still of interest to examine whether older women experience more about memory problems than men, and if such experiences are associated with scores on MMSE and MoCA.

To summarize, by searching the literature only a few community studies were found that compared total and the domain or item scores on MMSE and MoCA between older women and men. Although many studies have been carried out to examine associations between self-report of memory problems and future development of dementia, few community studies have been published that examined the association between a single question of memory complaint and the scores on MMSE and MoCA in older women and men. Thus, the aims of the present study were threefold: 1) to examine whether sex influenced on total and domain or item scores on MMSE and MoCA, 2) to examine sex differences between complainers and non-complainers of memory problems and 3) to examine whether scores on MMSE and MoCA differ between complainers and non-complainers. Based on the literature our hypotheses are that women compared to men will score higher on MoCA, but not on MMSE, and we expect that self-report of memory problems is more common in women than men, whereas the question is open whether older adults with self-report of memory problems score lower on MoCA and MMSE.

Material and Methods

Design and participants

This cross-sectional study took place between April and June 2019 together with the population-based Trøndelag Health Study in the city of Trondheim (HUNT4 Trondheim 70+.

For the present study to compare the results on MoCA and MMSE we invited 504 home-dwelling people aged 70 years and above that had participated in the HUNT study. In all, 309 (61.3%) consented to participate. The mean age of the 309 participants was 75.8 (SD 4.4) years; 155 were women with mean age 75.6 (SD 4.1) years and 154 were men with mean age 76.0 (SD 4.6) years. Those who declined participation were 100 women and 95 men. They did not differ from those who participated with regard to age (p= 0.91), sex, (p= 0.81) or educational level (p= 0.67). As all 504 were tested with MoCA as part of the ongoing HUNT4 study we could compare the scores of the 309 participants with the 195 that declined being tested with MMSE. Those who declined had a significantly lower score on MoCA compared to those who participated (23.5 (SD 3.5) vs.24.5 (SD 3.2), p= 0.002.

Assessments

All participants were tested with the 3rd Norwegian version of the MMSE and the Norwegian version (7.1) of MoCA at a test station at two visits within one week by trained health personnel. MoCA was applied at the first visit and MMSE at the second. The MMSE is a global screening test that tests orientation, memory, language and visuospatial function with scores from 0-30, a higher score indicates better cognition (6). The MoCA scale is also a multidomain cognitive screening instrument, testing memory, visuospatial and executive functions, naming, attention, abstraction, language and orientation with scores from 0-30, higher scores indicate better cognitive function (13). In addition, we used the Word List Memory Task (WLMT) from the Consortium to Establish a Registry of Alzheimer's disease [CERAD, 46]. It tests memory with a list of ten words which are repeated in different order three times, that should be recalled immediately after each presentation (immediate recall or learning) and recalled after ten minutes (delayed recall). Maximum score for immediate recall is 30 and for delayed recall 10. A higher score indicates better verbal memory performance [46]. We asked the participants two patient related outcome measures (PROM): a general question about memory problems: "have you experienced any memory problems" (yes/no), and a specific question: "have you experienced significant memory problems the last five years" (yes/no). Age at test date, sex and self-report of educational level expressed as years of schooling was recorded.

Statistics

For data recording and analyses we used the SPSS, 25th edition. Before analyses we divided the participants into three age groups: 70-74 years, 75-79 years and 80+ years. Educational level was divided into three groups according to the Norwegian school system fifty years ago. Ten years of schooling represented primary school + middle school, 11-12 years high school and 13 years and above academic education. Chi-square test was used to test for differences in table analyses, and with linear-by-linear association for 3x2 tables. As the normality assumption was violated for the test scores, Mann-Whitney U and Kruskal Wallis tests were used for group comparison of results on MMSE and MoCA. Bonferroni adjustment was used for multiple testing. Spearman's rho, a rank correlation test, was used for correlation analyses. To explore which variables were associated with the total MMSE and total MoCA scores, and the difference between MMSE and MoCA- scores, we conducted three multivariate linear regression analyses including sex, age, education and self-report of memory problems as independent variables. Enter, forwards and backwards stepwise methods were performed, which did not change the results. Results of the enter method were recorded.

Results

Personal characteristics of the participants and the results of the WLMT and the two PROM questions divided by sex are shown in table 1. As can be seen, no differences were found between women and men related to age groups, but fewer women had higher academic education compared to men ($p<0.001$). Women outperformed men on WLMT.

MMSE and MoCA *scores broken down by sex, age and education*

Results of the MMSE and MoCA broken down by sex, age, educational groups, and the two self-reported questions of memory problems are displayed in table 2. To further illustrate the different distribution of the scores between the two tests we added the number of people with a score below 26 on each test. It should be noted that only five persons had a score below 24 and six scored 24 on the MMSE. No one scored below 21 on the MMSE, whereas 31 women and 32 men, together 63 (20.4%) reached the maximum score of 30.

Although the total score on the MMSE and MoCA did not differ between women and men (table 2), stratifying the analysis by taking education into the analyses showed one difference. Women with 11-12 years of schooling scored significantly higher on total MoCA compared to men, 24.4 (SD 3.4) versus 22.7 (SD 3.4), $p= 0.005$ (adjusted with Bonferroni correction)). Otherwise, we found no differences on total MMSE and MoCA scores between women and

men in the various age and educational groups or according to self-report of memory problems.

Examination of the scores on the various domains/items revealed some differences between women and men. On MoCA, women scored significantly higher on the item delayed recall, see table 3. This sex difference was also found in the age group 70-74 years, age group 80 years+ and the group with education of 11-12 years with mean scores (s.d) for women and men: 3.1 (1.5) vs 2.6 (1.4), p= 0.003; 3.0 (1.7) vs 2.0, p= 0.04; and 3.2 (1.5) vs 1.8 (1.5), p <0.001, respectively.

Men had significantly higher scores than women on the items visuoconstruction (copying a cube and clock drawing test) and serial subtraction on MoCA, see table 3, and on the item serial-seven on MMSE 4.5 (0.8) vs. 4.1 (1.1.), p <0.001. Such differences between men and women were further found for some subgroups: visuocontruction (MoCA) men 70-74 years 3.9 (0.8) vs women 3.5 (1.2), p 0.01, serial subtraction (MoCA) men 75-79 years 2.8 (0.6) vs women 2.4 (0.9), p= 0.04 and serial-seven (MMSE) men with 13+ years of education 4.7 (0.6) vs women 4.2 (1.1), p= 0.001.

Correlations between MMSE and MoCA

We found a weak to moderate rank correlation between the total score on the two tests (Spearman's rho 0.36). We further calculated rho for women and men separately and for participants according to age and education. Spearman's rho varied and was lowest for the group with ≤ 10 years of schooling (0.16) and highest for the group with 11-12 years of schooling (0.43).

The mean difference between the MMSE and MoCA score was 3.7 (s.d. 2.7), highest on MMSE, and varied between 3.4 (SD 2.7) for participants with 13+ years of education (lowest) and 4.3 (S. 3.9) for those with education of 10 years and below (highest). Among all 277 (89.6%) had higher score on MMSE compared to MoCA, 18 (5.8%) had equal score on both test (11 were women) and 14 (4.5%, 11 were women) scored higher on MoCA. Those, who scored higher on the MoCA or equal on both tests were significantly younger (p= 0.004), had higher education (p= 0.02) and were women (p= 0.02).

Self-report of memory problems

For the two self -reported questions the prevalence of a "yes" was not different for women and men. For the question "have you experienced significant memory problems the last five years" we found several significant differences in scores on both the MMSE and MoCA for people who answered "yes" (lower scores) compared to those who answered "no" (higher scores) to this question, see table 4.

Multivariate linear regression analyses

Lastly, we performed three linear regression analyses, table 5. Using the MMSE score as the dependent variable we found that higher score on MMSE was associated with younger age, higher education and reporting no significant memory problems the last 5 years. Higher score on MoCA was associated to sex, age, education and reporting no memory problems last 5 years. These two regression models accounted for 15% and 14 % of the explained variance, respectively. The model using the difference of MMSE-MoCA as the dependent variable explained only 5% of the variance.

Discussion and conclusion

To summarise, according to the adjusted regression analysis we could confirm our hypothesis that women performed better on MoCA than men, but not on MMSE. We further found that women had higher score on the delay recall item on MoCA, and men outperformed women on the items serial seven on the MMSE and serial substraction and on the domain visuoconstruction on MoCA. Self-report of memory problems was equally common in men and women, and complaint about significant memory problems the last 5 years was associated with lower scores on MMSE and MoCA. In addition, the participants had in general a higher score on the MMSE compared to MoCA and the rank correlation between the two test scores was poor to moderate. Not surprisingly, we found that education and age influenced on both test scores.

In the adjusted regression analyses (table 5) we found that female sex was associated with a higher score on MoCA, but not on MMSE. This finding is in line with a few community studies [23-27]. However, this sex difference was not found by comparing the total MoCA scores among women and men displayed in table 2. The explanation for this diverse result shown in table 2 and 5 is probably because fewer women compared to men had education of 13 years and above, and very few men had low education (table 1). This imbalance could influence on the total scores on both tests. In the multivariate regression analyses the

difference in education between sexes was controlled for (men with education of 13 years and above had the highest score on MoCA). We did not find an association between sex and MMSE score in the adjusted regression analysis (table5), nor in total MMSE score. This suggests that the score on MMSE is not influenced by sex, possibly due to the recall item of the men MMSE (recalling three words) and the only spatial item (drawing two pentagons) are not sensitive enough to separate between women and men community study. Our finding is however, in contrast to another and larger community study that reported higher MMSE score in older women [27]. It should be noted that only 21 scored below 26 and 63 had a maximum score of 30 on MMSE. This narrow distribution of MMSE scores, having most scores between 26-29 could have influenced on the results.

The standardized beta in the regression analyses was about the same for the variable sex as for age and half of that of education. Comparable betas are reported by Borland et al, and Thomann et al., two community-based MoCA studies [25-26]. Thomann et al. estimated normative data of MoCA and could show that the score defining -1.5 standard deviation was one point higher in women compared to men, regardless of age and educational level [26]. We suggest that the estimated higher score in women in the study by Thomann et al can be related to better verbal memory performance in older women, but neither Borland et al. nor Thomann et al. reported scores on domains/items of the MoCA, so we cannot compare our findings with results from these two studies [25-26]. Direct comparison is further difficult as we have no normative data on MoCA in Norway. Several studies have shown that women, also older women, perform better than men on verbal memory tests [25-33, 47, 48]. Two larger studies could confirm that these differences were stable over a period of nine to 10 years in older adults [30, 33]. The present study confirms these previous findings as we could document significantly higher scores on the item delayed recall on MoCA and WLMT in older women compared to older men. However, performance on the delayed recall on the MMSE did not differ between sexes, probably because it is less challenging to remember three words of the MMSE compared to five of the MoCA and ten on the WLMT. We suggest that MoCA is superior to MMSE in this respect and is one reason why MCI is better detected by MoCA than MMSE, as most MCI cases are of amnestic nature [3]. Another explanation could be that MoCA and MMSE are differently constructed as MoCA cover more cognitive domains compared to MMSE, which could have implications when summarizing scores from sub-items into a total score. It is likely that sub-items testing many different cognitive functions (MoCA) will results in a different total score compared to sub-items testing less

different cognitive functions (MMSE). For this reason MoCA could be more sensitive to cognitive decline.

Not surprisingly, men scored better than women on serial seven on the MMSE and serial subtraction and visuoconstruction on MoCA, as found in previous studies [27-33]. However, these differences are judged to be of little significance for the total scores of the two tests, since the results had no significant effect in the adjusted regression analysis. Male sex was not associated with neither MoCA nor MMSE total score. We suggest that the sex differences on MoCA total and item scores should be further examined, since these differences could probably have a significant impact on normative data. Our results do not support that normative data for MMSE should be adjusted for sex differences.

About half of both women and men reported significant memory problems the last five years and no difference was seen between sexes. We suggest that this result is valid. A recent large epidemiological community-based study from Norway reported that 35% of adults above age 70 years had a diagnosis of MCI and a Swiss community-based study reported a prevalence of 18.5%. In addition, a review reported a prevalence of 23.8% for the diagnosis of subjective cognitive decline [42, 49, 50]. We suggest that raised awareness about memory problems as a possible first sign of dementia and insight in own decline of memory function by increasing age could explain the high proportion of complainers of both sexes. There is reason to believe that raised awareness and insight in own memory decline should be different in older women and men.

The association between scores on self-report of memory problems was not of significance for the general question of “do you experience any memory problems”, but it was for the more specific question “have you experienced significant memory problem the last five years”. This finding is in line with our hypothesis. In the unadjusted group comparison analysis (table 4) and the adjusted regression (table 5) this specific question was significantly associated to the score on both MMSE and MoCA. The standardized beta for this PROM question in the adjusted regression analyses was almost as high as for education in explaining the scores on the two tests, indicating that self-report of memory problem could be used as a first question to older people before performing a cognitive test. Older people answering “yes” to the question have higher probability to have a lower score on tests like MMSE and MoCA. The association between self-report of memory problems the last five years and scores on the two

tests indicates that this question could be used as one of various tools in the assessment of cognition and dementia. A few standardized self-report scales have been developed for clinical use, which are useful, but more time consuming than a single question [37, 39, 40]. One of these is the Cognitive Functional Impairment (CFI) scale, which contains 14 specific questions of cognitive problems [51]. In a recent study we found that this scale was valid for detecting older people with MCI, but not dementia [39]. This also indicates that people with normal or subnormal cognitive performance, or even MCI have good insight in own cognitive problems [39].

We could confirm the well-known findings that educational level and age influence on both test scores, which indicates that the data used in the present study are comparable with data of many other studies in the field [9, 13, 20-22, 52-53]. We could also confirm that older people score higher on MMSE than MoCA, probably because MoCA is more challenging, and lastly, we have shown that the rank correlation between the two tests is weak, and that the scores cannot be used side-by -side.

Clinical implications

Having confirmed that age and educational level influence on the total scores on both tests, the novel finding in this study is that sex as well influence on MoCA score, but not on the MMSE score. This is only reported in a few previous normative studies of MoCA, and only the study by Thomann et al. calculated separate normal scores for older women and men (23-26). The difference in MoCA score in the Swiss normative study was small, and the influence of sex according to the linear regression analysis (table 5) on MoCA score in the present study was as well small. Based on the results of the present study we cannot recommend any normative scores for older women and men. We suggest that future normative large- scale studies of MoCA should include sex, not only age and education in developing normative scores.

Limitations

Although the older adults were selected randomly, we cannot claim that the sample is representative for the older population of Trondheim, since 195 of 504 declined participation. Those who declined had significantly lower score on MoCA, but they did not differ from the participants regarding sex, age and education. According to the MMSE scores, especially, few participants had severe cognitive impairment, meaning that the sample is not representative

for this group of older adults. But, as the main aim of the study was to examine differences between sexes with regard to scoring on MMSE, MoCA and self-report of memory loss, we assume that the sample is representative in that respect. Another limitation is that several health workers did the testing, and we cannot exclude that test results could have been influenced by the health worker's various experience. To increase inter-rater reliability all health workers did the same training before the study. Some of the items of MMSE and MoCA are similar, but most of them are not identical. Therefore, some learning effects could not be excluded, as the two tests were administered within one week. The sample is relatively small, but as we found comparable results with other larger studies examining the influence of age and education, we assume that our dataset was satisfying to answer our research questions [16, 17]. Another limitation to consider is that we did not further examine if the participants had a diagnosis of dementia., and thus, we cannot exclude that some of the participants have dementia. Nevertheless, most participants had a high score on both tests, making it unlikely that many could have dementia. Only 11 persons scored between 21 and 24 on the MMSE, a finding that also support that only a few could have had dementia.

Conclusions

The main results of the study are that MoCA scores are associated with younger age, higher education and female sex, whereas sex was not associated with MMSE score. Older women scored significantly better than men on the item recalling five words on MoCA, whereas men scored significantly higher on the domain visuoconstruction on MoCA and the items serial substraction on MoCA and serial seven on MMSE. The question "have you experienced significant memory problems the last five years" was significantly associated with both MoCA and MMSE score and may be useful to evaluate older people's cognition.

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Ethics

All participants received oral and written information about the study and gave informed written consent. The project was submitted to the Regional ethics Committee for Medical and Health Research (REC) in Mid-Norway, reference REK 2018/1812, and was approved. It was further approved according to the General Data Protection Regulation (GDPR) by the Norwegian Centre for Research Data (NSD).

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Authors contribution

Knut Engedal designed the study, analysed and evaluated the data and wrote the preliminary and final draft of the manuscript, and approved it

Linda Gjøra took part in design of the study, organised data and gave input to evaluation of the analysis, the preliminary and final draft of the manuscript, and approved it.

Thea C Bredholt gave input to evaluation of the analysis, the preliminary and final draft of the manuscript, and approved it.

Pernille Thingstad gave input to evaluation of the analysis, the preliminary and final draft of the manuscript, and approved it.

Gro G Tangen gave input to evaluation of the analysis, the preliminary and final draft of the manuscript, and approved it.

Linda Ernstsen gave input to evaluation of the analysis, the preliminary and final draft of the manuscript, and approved it.

Geir Selbæk took part in design of the study and gave input to evaluation of the analysis, the preliminary and final draft of the manuscript, and approved it.

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Table 1. Characteristics of the participants

	All, n=309	Women, n=155	Men, n=154	P value
Age groups, n=309				
70-74 years, n (%)	169	89 (52.6%)	80 (47.3%)	0.49
75-79 years, n (%)	87	43 (49.4%)	44 (50.6%)	
80 years +, n (%)	53	23 (43.4%)	30 (56.6%)	
Education, n=305				
≤ 10 years, n (%)	23	20 (87.0%)	3 (13.0%)	< **0.001**
11-12 years, n (%)	115	66 (57.4%)	49 (42.6%)	
13 years +, n (%)	167	66 (39.5%)	101 (60.5%)	
WLMT, n=247				
Immediate recall, mean (SD)	19.5 (3.8)	20.3 (3.7)	18.8 (3.9)	**0.001**
Delayed recall, mean (SD)	5.8 (2.1)	6.2 (2.0)	5.3 (2.1)	**<0.001**
Self-report of memory problems				
Any problem*, yes (%)	206	97 (47.1%)	109 (52.9%)	0.13
Sign. problem last 5 ys**, yes (%)	129	69 (53.5%)	60 (46.5%)	0.35

WLMT World List Memory Task

* have you experienced any memory problems? ** have you experienced significant memory problems the last five years?

Table 2. Total scores on the MMSE and MoCA by sex, age, education and self-report of memory problems.

	MMSE			**MoCA**		
	Mean (SD)	<26, n (%) Total 21	P value	Mean (SD)	<26, n (%) Total 182	P value
Sex						
Women	28.0 (1.8)	15 (9.6%)	a 0.21	24.6 (3.3)	87 (56.1%)	a 0.35
Men	28.4 (1.4)	6 (3.9%)	b 0.04	24.3 (3.1)	95 (61.7%)	b 0.32
Age						
70-74 years,	28.5 (1.3)	4 (2.4%)	a 0.01	24.9 (2.7)	91 (53.8%)	a 0.05
75-79 years	27.9 (1.9)	11(12.6%)	b 0.003	24.2 (3.5)	53 (60.9%)	b 0.01
80 years +	27.6 (1.8)	6 (11.3%)		23.4 (3.9)	38 (53.0%)	
Education, 305						
≤ 10years	26.9 (2.3)	6 (26.1%)	a < 0.001	22.6 (4.0)	17 (73.9%)	a < 0.001
11-12 years	27.9 (1.6)	8 (7.0%)	b < 0.001	23.7 (3.5)	75 (65.2%)	b 0.01
13 years +	28.6 (1.4)	7 (4.2%)		25.2 (2.7)	88 (53.0%)	
Memory						
Any problem	28.2 (1.8)	12	a 0.59	24.3 (3.3)	127	a 0.52
No problem	28.2 (1.5)	9	b 0.34	24.8 (3.1)	55	b 0.17
Problem, 5 ys*	27.7 (1.8)	15	a < 0.001	23.7 (3.5)	90	a <0.001
No problem,5y**	28.5 (1.4)	6	b 0.02	25.0 (2.8)	92	b 0.001

a) Mann-Whiney U or Kruskal Wallis test; comparison of test scores within each group,

b) Chi-square test, with linear-by linear association for 2x3 tables; comparison of persons scoring below 26 within each group

* have you experienced any memory problems? ** have you experienced significant memory problems the last five years?

Table 3. Gender Differences in Mean scores on 10 sub items/scale of the MoCA

	Women	Men	p value
	Mean (SD)	Mean (SD)	
Alternative trail making test, drawing a cube and clock drawing test, max 5 points	3.5 (1.2)	3.8 (1.0)	**0.03**
Animal naming, max 3 points	2.9 (0.3)	2.9 (0.3)	0.80
Digit span, max 2 points	1.8 (0.5)	1.8 (0.5)	0.61
Letter tapping, max 1 point	0.95 (0.2)	0.95 (0.2)	0.78
Serial subtraction, max 3 points	2.5 (0.8)	2.7 (0.6)	**0.03**
Recall sentence, max 2 points	1.6 (0.6)	1.6 (0.7)	0.68
Word fluency, max 1 point	0.8 (0.4)	0.7 (0.5)	0.07
Abstraction, max 2 points	1.6 (0.7)	1.6 (0.7)	0.80
Delayed recall, max 5 points,	3.0 (1.6)	2.4 (1.6)	< **0.001**
Orientation, max 6 points	5.9 (0.4)	5.9 (0.4)	0.19

p Mann- Whitney U test

Table 4. Scores on the MMSE and MoCA among those who reported significant memory problems last 5 years, broken down by sex, age and educational groups, n=309.

	MMSE score, mean (SD)			**MoCA score, mean (SD)**		
	Problem	No problem	p value	Problem	No problem	p value
Sex						
Women	27.5 (2.0)	28.4 (1.5)	**0.001**	23.8 (3.8)	25.2 (2.7)	**0.02**
Men	28.3 (1.4)	28.6 (1.3)	**0.01**	23.5 (3.3)	24.7 (2.9)	**0.01**
Age groups						
70-74 years	28.1 (1.5)	28.7 (1.2)	**0.007**	24.2 (3.6)	25.2 (2.4)	**0.02**
75-79 years	27.5 (2.0)	28.2 (1.8)	**0.003**	23.2 (3.9)	24.9 (3.1)	**0.046**
80 years +	27.4 (2.0)	28.1 (1.5)	0.22	23.2 (4.0)	23.7 (3.9)	0.49
Education						
$\leq$ 10 years	27.1 (2.5)	26.7 (2.1)	0.53	22.8 (4.8)	22.4 (3.4)	0.88
11-12 years	27.4 (1.8)	28.3 (1.3)	**0.004**	22.8 (3.6)	24.4 (3.2)	**0.01**
13 years+	28.2 (1.6)	28.8 (1.2)	**0.006**	24.5 (3.1)	25.6 (2.3)	**0.02**

Table 5. Three multivariate linear regression analyses with MMSE, MOCA and the difference between MMSE-MoCA scores as dependent variables and sex, education, age and self-report of significant memory problems last five years as independent variables.

	MMSE		**MoCA**		**Diff MMSE-MoCA**	
	standardized beta	p value	beta	p value	standardized beta	p value
Sex 0 = women, 1= men	0.039	0.48	-0.128	**0.02**	0.156	**0.001**
Age	-0.124	**0.03**	-0.122	**0.03**	-0.091	0.12
Education 0= <10 years (ref)	0.266	< **0.001**	0.277	< **0.001**	0.024	0.69
Memory problem last 5 years 0= no, 1=yes	-0.178	**0.001**	-0.160	**0.004**	0.004	0.95
Explained variance	15 %		14 %		4 %	