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Prevalence of Mild Cognitive Impairment by Multiple Classifications: The MYHAT Project

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Abstract

Objectives—To estimate and compare the frequency and prevalence of mild cognitive impairment (MCI) and related entities using different classification approaches at the population level.

Design—Cross-sectional epidemiologic study of population-based cohort recruited by age-stratified random sampling from electoral rolls.

Setting—Small-town communities in western Pennsylvania, USA

Participants—Of 2036 individuals aged 65 years and older, 1982 participants with normal or mildly impaired cognition (age-education-corrected Mini-Mental State scores ≥ 21).

Measurements—Demographics, neuropsychological assessment expressed as cognitive domains, functional ability, subjective reports of cognitive difficulties; based on these measurements, operational criteria for the Clinical Dementia Rating (CDR) scale, the 1999 criteria for Amnestic MCI, the 2004 Expanded criteria for MCI, and new, purely cognitive criteria for MCI.

Results—A CDR rating of 0.5 (questionable dementia) was obtained by 27.6% of participants, while 1.2% had CDR ≥ 1 (mild or moderate dementia). Among those with CDR <1, 2.27% had Amnestic MCI and 17.61% had Expanded MCI, while 34.6 % had MCI by purely cognitive classification. Isolated executive function impairment was the least common, while impairment in multiple domains including executive function was the most common. Prevalence estimates weighted against the US Census are also provided.

Conclusions—The manner in which criteria for MCI are operationalized determines the proportion of individuals who are thus classified, and the degree of overlap with other criteria. Prospective followup is needed to determine progression from MCI to dementia, and thus empirically develop improved MCI criteria with good predictive value.

Keywords

MCI criteria; subjective memory; epidemiology

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Objective

With growing acceptance of the broad concept of mild cognitive impairment (MCI) as a cognitive state intermediate between normal aging and dementia, the existence of many competing definitions and criteria for MCI is not a trivial issue. Given the likely overwhelming global incidence of dementia in the decades ahead, (1) there is interest in identifying individuals with Alzheimer's disease (AD) and other dementias in the pre-dementia or preclinical stage, so that early intervention can be offered. The difficulties lie both in accurate identification of such cases, and in development of effective therapies. These difficulties compound each other, because without accurate identification of when mild impairment represents prodromal AD, trials of potential early interventions are likely to fail. Much of the variation in study results comes from differences in populations examined and methods (including criteria) applied. (2,3) The data most relevant to public health are those from unbiased samples drawn from the population at large. In a large, new, population-based cohort of older adults, we applied several classifications of mild cognitive impairment and related entities to determine their overlap, and to estimate their prevalence.

Methods

Study area, sampling, and recruitment

The study cohort named the Monongahela-Youghiogheny Healthy Aging Team (MYHAT) is an age-stratified random sample of the population aged 65+ years in a small-town region of the USA. Community outreach and recruitment procedures were approved by the University of Pittsburgh Institutional Review Board. Additional details have been reported previously. (4,5) Recruitment criteria were (a) age 65 years or older, (b) living within the selected area, (c) not already in a long-term care institution. Individuals were ineligible if they were too ill to participate, had vision or hearing impairment too severe to allow neuropsychological assessment, or were decisionally incapacitated. Over the approximately two-year recruitment period, a total of 2036 individuals were recruited.

Assessment (overview)

In a single-stage field assessment, (6) the Mini-Mental State Examination (MMSE) (7) was administered and scored on the spot, applying a standard correction for age and education. (8) By scoring <21 /30 (age-education-corrected), 54 individuals (2.7%) were classified as moderately to severely cognitively impaired and therefore unsuitable for studying MCI. These individuals were not assessed further. The remaining 1982 participants, who scored ≥21 on the MMSE, were regarded as having normal or only mildly impaired cognition. They proceeded to the full assessment, of which the relevant components are described below.

Neuropsychological assessment

Cognitive functioning was assessed by a battery of tests, categorized in Table 1 according to the principal cognitive domain they tap. Published norms (5) on these tests from MYHAT participants free of dementia are also available on our study website (http://www.wpic.pitt.edu/research/dementia_epidemiology/MYHAT/MYHATHomePage.htm). The MYHAT Cognitive Classification described below is based on these norms.

Cognitive domain composites—Each test was first transformed into the standardized score by centering to its mean value and dividing by its standard deviation. The arithmetic mean of the standardized scores on all tests in a given cognitive domain was then calculated

as the final composite score for that domain, except for the visuospatial domain which is comprised of a single test. A domain score was considered missing if the participant completed no tests in that domain.

Subjective Cognitive Symptoms

Using a standardized questionnaire,(9) (Table 2) participants were first asked two general questions “How good do you feel your memory is for a person your age?” and “Do you feel you remember things less well than you did a year ago?” They were then asked whether they thought they were better, the same, or worse than before at 16 specific “remembering” items. Coding responses to these 16 “remembering” items as 1/0 (worse/same or better), the responses were summed for a total score ranging from 0-16. On this total score, the 50th percentile was 1; a threshold of 2 “remembering” symptoms was used as the cutoff for “memory complaint” for Amnestic MCI (10) described later. Five additional items not pertaining to “remembering” were also asked and coded as 1/0 (worse/same or better); summing all 21 responses for a possible total score ranging from 0-21, the median score was 2. A score of 2/21 (50th percentile) was used as the cutoff for “cognitive complaint” for Expanded MCI, (11) described later. In post-hoc analyses we also examined the results of using a threshold of 5 (90th percentile), and of treating the two initial general self-report memory questions as representing subjective memory/cognitive complaint, instead of the number of specific cognitive symptoms endorsed.

Everyday Functional Ability

Instrumental activities of daily living (IADL) were assessed using the Older Americans Resources and Services (OARS) scale (12) which asks whether the individual can carry out independently, with some help, or not at all, seven activities: getting to places outside walking distance; using the telephone; going shopping for groceries and clothes; preparing own meals; doing housework; managing medicine; handling money. Note the OARS assesses impairment due to any/all causes and does not enquire specifically whether difficulty is related to physical (motor, sensory) or mental (cognitive, motivation) impairments.

These responses were scored as 1/0 (unable vs. independently able or able with help) and a total IADL impairment score derived by summing the responses for a possible range of 0–7. As the 90th percentile score on this scale is 1 (i.e. 83.7% of the cohort reported being able to perform all IADLs independently or with help), we treated a score of 0 (no impairments) as the threshold for these analyses. Scores were prorated for 45 individuals, all men, who had never prepared meals or done their own housework (items 4 and 5). In post-hoc analyses, we recoded the IADL data so that 1/0 reflected unable or able only with help vs. independently able, and once again used a total score of 0 (97.6th percentile) as the threshold for IADL impairment.

Classifications of MCI

1. Clinical Dementia Rating

Interviewers trained and certified by the Washington University online training program (13) rated participants on the Clinical Dementia Rating (CDR) scale,(14,15) based on the participant's daily functioning in the six areas of memory, orientation, judgment, home and hobbies, community affairs, and personal care. Relevant assessment items included the subjective cognitive functioning and IADL questions listed earlier, and also social engagement, community activities, hobbies and interests, employment, participants' understanding of own medication regime, social judgment, and the interviewers' overall impression. Importantly, these assessments are not based on neuropsychological test

performance. Each of the six areas obtains a box score rated on a scale of 0 through 0.5, 1, 2, and 3. A summary CDR rating of 0 (no dementia), 0.5 (very mild dementia), and 1.0 through 3.0 (mild, moderate, and severe dementia) is generated using an algorithm which is weighted towards memory. In addition, a CDR Sum of Boxes (SoB) (a simple aggregate of the box scores for the six areas, without differentially weighting any of them) is calculated, with a potential range of 0–18.

2. MYHAT Cognitive Classification

In contrast to the CDR, which is based purely on everyday functioning, we developed a Cognitive Classification to classify participants solely on the basis of their neuropsychological test performance. Cognitive domain composites were derived as described earlier. Normative reference points were created for each domain: excluding participants with dementia (CDR ≥1), means and standard deviations of each domain composite score were calculated for each age-sex-education group. Based on these reference points, participants were classified as follow: (a) normal: composite scores in all domains within 1.0 SD of the appropriate mean; (b): dementia: composite scores in at least two domains ≥ 2.0 SD below the mean for the individual's reference group; (c) MCI, single domain (focal): composite scores in one domain >1.0 SD below the appropriate mean, with all other domains normal, i.e. within 1.0 SD of the mean; (d) MCI, multiple domains: two or more domain composite scores 1.0 – 2.0 SD below the mean, or no more than one domain >2.0 SD below the mean with other domain(s) 1.0 – 2.0 SD below the mean.

3. 1999 criteria for Amnestic MCI

We operationalized the original Mayo criteria (aka Petersen criteria) for Amnestic MCI(10) as follow.

- **i.** *Memory impairment:* Memory domain composite score >1.0 SD below the mean for age/sex/education.
- **ii.** *Memory complaint*: 2 or more items endorsed from the first 16 subjective cognitive symptoms. (Table 2)
- **iii.** *Normal mental status*: MMSE ≥ 21 (standard MMSE without age-education correction); non-memory domain composite scores within 1.0 SD of their means.
- **iv.** *No functional impairment:* all IADL items reported as able to perform independently or with some help.
- **v.** *Absence of dementia:* CDR <1.

4. 2004 criteria for Expanded MCI (all domains)

The revised and expanded MCI criteria (11) (aka Winblad criteria) were operationalized as follow:

- **i.** *Cognitive impairment:* Since the 2004 criteria do not specify psychometric thresholds, our operational definition is identical to those for MYHAT Cognitive Criteria: one or more cognitive domain composite scores impaired relative to appropriate mean for age/sex/education. According to the number of domains impaired, MCI was classified as single domain (focal) or multi-domain; each of these was further classified as amnestic or non-amnestic, depending on whether the memory domain was impaired.
- **ii.** *Cognitive complaint*: 2 or more items endorsed out of all 21 subjective cognitive symptoms (Table 2).
- **iii.** *Normal mental status*: standard MMSE ≥ 21.

iv. *No or minimal functional impairment:* All IADL items reported as able to perform independently or with help.

v. *Absence of dementia*: CDR <1.

Statistical Analyses

Simple descriptive statistics included means, standard deviations, percentiles, and proportions. The frequency and percent of individuals meeting each criterion and criterion set were calculated, with relevant entities cross-tabulated. For the key MCI entities, prevalence was estimated for the general population aged 65+ of the selected towns in the Monongahela-Youghiogheny area using weights calculated based on our sampling scheme and the U.S. Census Bureau, 2005 Population Estimates (www.census.gov) for the area.

Results

Sample size and demographics

Of the original cohort of 2036 individuals, the current sample included 1982 participants with normal or mildly impaired cognition (age-education corrected MMSE ≥21). At study baseline, their mean (SD) age was 77.6 (7.4) years with a range of 65 to 99 years. Women comprised 61.1%; 94.8% were Caucasian; 13.8%, 45.1%, and 41.1% had less than high school, high school, and more than high school.

Clinical Dementia Rating

The algorithmically derived CDR summary stage of 0 (“no dementia”), which is weighted towards memory function, was obtained by 1413 (71.3%) of participants. A CDR stage of 0.5, representing “very mild dementia” and equated with MCI (16) was obtained by 546 (27.6%). The remainder of the analyses reported here exclude 23 individuals with CDR stage ≥1.

Cognitive Classification

Table 1 shows the frequency and proportion of participants with mild single- and multiple-domain impairments by cognitive domain, for a total of 687 individuals (34.7%) with purely cognitively defined MCI (and CDR <1). While isolated executive function impairment was the least common single-domain MCI, multiple- domain MCI including executive function was the most common. Conversely, while isolated attention/processing speed impairment was the most common single-domain MCI, multiple domain MCI including attention/speed was the least common.

Mayo Criteria for MCI

Of the sample of 1982, 45 individuals (2.27%) fulfilled our operational version of the original Amnestic MCI criteria (10) while 349 (17.61%) were classified by the Expanded MCI criteria. (11) Table 3 shows the proportions who met each of the individual criteria, cumulative combinations of criteria, as well as those unclassifiable by each criterion because of missing memory test data (n=23), other cognitive test data (n=191), or IADL/subjective complaint data (n=7).

Post-hoc analyses examined variations in these operational definitions. For “memory complaint/cognitive complaint,” raising the threshold from the 50th percentile of 2 specific symptoms to the 90th percentile of 5, the frequency of Amnestic MCI (10) fell from 45 (2.4%) to 20 (1.0%), while that of Expanded MCI (11) fell from 349 (17.6 %) to 137 (6.9%). Substituting the general self-report of memory for the specific symptoms had the following effects: for the Amnestic MCI, self- assessment as memory worse than a year ago, memory

poor for a person of the same age, and either one or the other, lowered the frequency to 25 (1.3%), 24 (1.2%), and 34 (1.7%). For Expanded MCI, the corresponding frequencies fell to 172 (8.7%), 143 (7.2%), and 246 (12.4%).

For "absence of functional impairment," recoding the IADL measurement so that only the ability to carry out each activity independently was treated as normal, the frequency of Amnestic MCI (10) fell from 45 (2.4%) to 36 (1.8%) and that of Expanded MCI (11) dropped from 349 (17.6%) to 253 (13.1%).

Mapping of MCI

We used the CDR_SoB to anchor or "map" (17) the various MCI definitions within our cohort (Table 4). For example, reading across, 31.1% of those with Amnestic MCI,(10) 37.5% of those with Expanded MCI, (11) and 57.9% of those with MYHAT Cognitive MCI, had CDR_SoB ratings of 0.

We emphasize that the sample is restricted to individuals with age-education-adjusted MMSE ≥ 21 and CDR summary score <1. However, of 23 individuals with CDR ≥ 1 (not in Table), the purely cognitive classification identified 10 as demented, 12 as multi-domain amnestic MCI, while the remaining individual completed no cognitive tests and could not be classified.

Prevalence

Using the frequencies and proportions reported in Table 4, and based on our sampling frame, weighted prevalence estimates for the population aged 65+ years were 2.18% for Amnestic MCI, and 17.60% for Expanded MCI. For comparison, 25.41% were classified as Very Mild Dementia according to a CDR summary stage=0.5, while our purely cognitive classification identified 35.14% of the population as being mildly cognitively impaired (Table 5).

Conclusions

Our study represents an empirical approach to implementing several extant clinically-driven MCI criteria in a population-based setting, where participants are not patients seeking care for cognitive problems, where expert clinical judgment cannot be brought to bear at the individual level, and not all participants have informants, reliable or otherwise. Our methods diverged from those of previous studies in that we used a single-stage assessment, all assessments were performed in the field by interviewers who were highly trained but not expert clinicians, and that subjective difficulties were reported by study participants themselves. We also treated attention/processing speed as a separate cognitive domain rather than including it within executive functions. Reassuringly, our broad findings are mostly as expected. More importantly, they demonstrate that the manner in which criteria are operationalized determines the number of individuals who will meet those criteria; that the more criteria included in a given classification, the fewer the people who will be thus classified; and that there is considerable but not total overlap and agreement among the different ways of classifying individuals as being mildly cognitively impaired. In this report, we have restricted analyses and discussion to MCI at the syndromic level and do not address its etiologic subtyping.

The Clinical Dementia Rating (CDR) (14,15) was originally developed to reflect severity or "stages" of dementia. Stage of 0.5, originally described as questionable or very mild dementia, in between the stages of 0 (no dementia) and 1 (mild dementia), has more recently been equated with mild cognitive impairment. (16) Using the CDR sum of boxes (SoB), rather than the stage, to minimize (although not eliminate) the special emphasis on memory-

related functioning, we “mapped” (17) and partly validated the various MCI criteria examined in this study. As current MCI criteria (10,11) are based on some of the same elements (IADL, cognitive symptoms/complaints) as the CDR, they track the CDR more closely than does the purely cognitive MYHAT classification that we examined simultaneously. However, general concurrence is suggested by the fact that between 60% and 80% of individuals classified as MCI by any of the three definitions had CDR-SoB scores of 0 or 0.5. In the population setting, and possibly also in the non-research clinical setting, many individuals may not attempt or complete one or more neuropsychological tests, or answer certain questions, because of cognitive or sensory impairment, motivation, anxiety, or combinations thereof. Regardless of the reason, absence of cognitive or self-report data will render the individual unclassifiable by any criterion set that requires those data. The CDR, being an overall impression based on both subjective reports and interviewer observations, can be rated in all participants, in the absence of objective cognitive measurements, whether or not it provides the complete picture. However, outside specialty settings, raters are not expert clinicians, and reliable informants are frequently unavailable for normal and mildly impaired individuals.

In the population-based, age-stratified MYHAT cohort, less than 3% overall were classified as having moderate to severe cognitive impairment, based on mental status screening with the age-education-corrected MMSE. (7,8) Of those with MMSE scores ≥21, a further 1.2% were rated as having dementia with CDR stage ≥ 1. In the remaining participants, applying fully operationalized criteria, the weighted population prevalence estimates were 2.18% for Amnestic MCI, (10) and 17.6% for Expanded MCI. (11) In contrast, the prevalence estimate was 25.4% for purely functional mild impairment as indicated by a CDR stage=0.5, and 35.14% for the purely cognitive classification. The discrepancies are as expected and clearly reflect the nature and specific components of the criterion sets. The CDR is based on the trained rater's impression of the participant's cognitively-driven functions based on self-report and observation, but not on objective test performance. The cognitive criteria are based purely on neuropsychological test performance relative to norms. Both had relatively high prevalence. When subjective as well as objective components are required, as in the Amnestic and Expanded MCI criteria, the prevalence drops as a function of the definition.

In 1997, an entity named Cognitive Impairment, No Dementia (CIND) was reported in 16.8% of participants, (a prevalence double that of dementia), in the Canadian Study of Health and Aging.(18) In that study, a sub-entity of 5.3% demonstrated “circumscribed memory loss” which appears similar to amnestic MCI described by the Mayo group in 1999. (10) The Indianapolis Study of Health and Aging reported CIND in 23.4% of their population. (19) The Cardiovascular Health Study had overall MCI prevalence of 22% with focal amnestic MCI in 6%, (20) and our own previous Monongahela Valley study found Amnestic MCI in about 3%.(21) In the Leipzig study, prevalence ranged from 3% to 20%, (2) and in the MRC-CFAS study, prevalence ranged from 0.1% to 42%, depending on the classification. (3) Regarding subjective cognitive symptoms, only 1.4 % of our participants with normal or mildly impaired cognition reported memory being worse than expected at their age, and only 23 % felt they remembered things less well than a year earlier. A systematic review of clinical and population-based studies found a range of 25%- 50% reporting everyday memory problems with methodological differences responsible for some of the variation. (22) Thus, population-based studies have repeatedly demonstrated that prevalence of MCI depends on the not just the criteria used but the way they were operationalized. Indeed, Petersen has stated that the Mayo Criteria were never intended to be operational criteria but rather to serve as guidelines for expert clinicians, posing a challenge for population studies.(23)

All current criteria are based on solid conceptual grounds; in clinical and clinical research settings, expert clinical judgment is explicitly applied. The common ultimate purpose of all MCI criteria is to identify those individuals with mildly impaired cognition who will undergo further decline and go on to develop frank dementia, and distinguish them from those who will remain stable or even improve. In the absence of a credible biomarker for a given dementing disease, progression to clinical dementia remains the true gold standard for MCI studies. Quite possibly, individual components of various criterion sets will be found to have varying predictive value. Few clinicians would advocate diagnosing prodromal AD on the basis of cognitive measurement alone, without obtaining a history of subjective impairment and functional difficulties; however, in one prospective study, a greater proportion of cognitively classified MCI progressed to dementia than those with CDR stage 0.5. (24) In another study of primary care patients, the participant's overall self-assessment of memory for age was more strongly associated with memory performance than perception of memory loss or specific cognitive difficulties. (9) A study of individuals with cardiovascular disease found that subjectively reported cognitive difficulties predicted cognitive decline over the subsequent year. (25) The MYHAT study will be in a position to shed further light on these issues with continued followup of this cohort.

For clinicians, the bewildering proliferation of criteria and concepts surrounding MCI is not merely a source of frustration but may well lead to overdiagnosis or underdiagnosis, and thence to inappropriate provision or withholding of treatment. A worthy research goal is to determine their predictive value of the various criteria for progression from MCI to dementia, as indeed many ongoing studies are now doing. Only prospective studies of unbiased cohorts will yield information that can be generalized to patients outside specialty settings and to the community at large.

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Table 1

MYHAT Cognitive Classification of Impairment[1]

Neuropsychological Tests (reference #s)	Cognitive Domain (composite)	Single Domain Impairment[2] N=400		Multiple Domain Impairment[3] N=287	
		n	*% (out of 400)*	n	*% (out of 287)*
WMS-R Logical Memory. (26) WMS-R Visual Reproduction. (26) Fuld OME with Semantic Interference (27,28)	Memory	89	*22.3*	150	*52.3*
Boston Naming Test. (29) Verbal Fluency Categories (animals). (30) IU Token Test. (31,32)	Language	54	*13.5*	153	*53.3*
Trail Making Test A (33) Digit Span Forward. (26)	Attention/Processing Speed	110	*27.5*	133	*46.3*
Trail Making Test B. (33) Clock Drawing (34) Verbal Fluency Letters (P&S) (30)	Executive Function	49	*12.3*	155	*54.0*
WAIS-III Block Design. (35)	Visuospatial Function	98	*24.5*	139	*48.4*

[1] Sample restricted to 687 individuals with cognitively defined MCI and CDR <1.

[2] The single domain groups are mutually exclusive.

[3] The multiple domain groups are not mutually exclusive, since e.g. an individual with impairments in both memory and language would be listed under both domains.

Table 2

Subjective Cognitive Symptoms

GENERAL SYMPTOMS		**n**	**(%)**[1]
a	How good do you feel your memory is for a person your age? (poor)	27	*1.4*
b	Do you feel you remember things less well than you did a year ago? (yes)	454	*23.2*
SPECIFIC SYMPTOMS			
Are you worse at … (yes)			
"Remembering" symptoms [2]			
1	things (events, people) from a long time ago?	218	*11.1*
2	things that happened or were said a few days ago?	429	*21.9*
3	appointments, messages, etc.?	161	*8.2*
4	names of people you have known for a long time?	482	*24.6*
5	names of people you have only met recently?	654	*33.4*
6	telephone numbers of people you call often?	184	*9.4*
7	locations of items (keys, watches, glasses, etc.) you use often?	358	*18.3*
8	how to use familiar tools and gadgets?	17	*0.9*
9	a familiar/favorite recipe without looking it up?	79	*4.0*
10	the right word to describe a familiar object?	601	*30.7*
11	the current day, date, or month?	138	*7.1*
12	a recent major event, like a trip or a wedding?	31	*1.6*
13	details of a major recent event?	102	*5.2*
14	time relationships of different events?	145	*7.4*
15	a few things needed to buy at the store, without writing them down?	327	*16.7*
16	to perform important routine activities, like turning off the stove or locking the door?	62	*3.2*
Other symptoms [3]			
17	solving problems as easily as before?	160	*8.2*
18	understanding what is going on or being said around you?	14	*0.7*
19	getting along with people, talking and behaving the way you used to do?	18	*0.9*
20	handling a household emergency like a plumbing leak or a kitchen fire?	31	*1.6*
21	keeping up with your hobbies and interests?	89	*4.6*

[1] % of 1959 individuals with Clinical Dementia Rating <1.

[2] "Remembering" items 1-16 considered under "memory complaint" for Amnestic MCI.

[3] All items 1-21 considered under "cognitive complaint" for Expanded MCI.

Table 3

Operational definitions of Amnestic and Expanded MCI criteria

Individual Criteria		Amnestic MCI (Petersen 1999) N = 45				Expanded MCI (Winblad 2004) N = 349			
		meet criteria n	(%)[1]	*missing* n	(%)[1]	*meet criteria* n	(%)[1]	*missing* n	(%)[1]
A	Cognitive impairment: Domain composite score(s) >=1 SD below mean	89	*4.49*	23	*1.16*	703	*35.47*	16	*0.81*
B	Cognitive complaint: subjective reports >=2	970	*48.94*	6	*0.30*	1032	*52.07*	6	*0.30*
C	Absence of functional impairment: IADL =0	1918	*96.77*	7	*0.35*	1938	*97.78*	7	*0.35*
D	Normal mental status: MMSE >=21[2]	1911	*96.42*	0	*0.00*	1931	*97.43*	0	*0.00*
E	Absence of dementia: CDR<1	1930	*97.38*	0	*0.00*	1951	*98.44*	0	*0.00*
	A+B	48	*2.42*	28	*1.41*	383	*19.32*	21	*1.06*
	A+B+C	47	*2.37*	32	*1.61*	368	*18.57*	25	*1.26*
	A+B+C+D	45	*2.27*	32	*1.61*	353	*17.81*	25	*1.26*
	A+B+C+D+E	45	*2.27*	32	*1.61*	349	*17.61*	25	*1.26*

[1] The denominator is all participants (n=1982), including 32 and 25 individuals with missing data for Amnestic MCI and Expanded MCI respectively. For Expanded MCI Individuals with missing memory data could still be classified according to data in other cognitive domains.

[2] For Amnestic MCI, “normal mental status” also required non-memory domains to be <1.0 SD below their means.

Table 4

Mapping MCI criteria in relation to clinical dementia rating[1]

CDR Sum of Boxes (SoB)	Amnestic MCI (1999 criteria)	Expanded MCI (2004 criteria)					MYHAT Cognitive Classification				
	Total 1999	Amnestic		Non-Amnestic		Total 2004	Amnestic		Non Amnestic		Total Cognitive
		Single Domain	Multi Domain	Single Domain	Multi Domain		Single Domain	Multi Domain	Single Domain	Multi Domain	
	N	*n*	*n*	*n*	*n*	*N*	*n*	*n*	*n*	*n*	*N*
		row%	*row%*	*row%*	*row%*		*row%*	*row %*	*row%*	*row%*	
	col%	*col%*	*col%*	*col%*	*col%*	Col%	*col%*	*col%*	*col%*	*col%*	Col%
0 *(n=1343)*	**14**	14	16	79	22	**131**	51	55	217	75	**398**
		10.69	12.21	60.31	16.79		12.81	13.82	54.52	18.84	
	31.11	31.11	19.28	51.97	31.88	**37.54**	57.3	36.67	69.77	54.74	**57.93**
0.5 *(n=352)*	**15**	15	40	45	21	**121**	19	53	58	25	**155**
		12.40	33.06	37.19	17.36		12.26	34.19	37.42	16.13	
	33.33	33.33	48.19	29.61	30.43	**34.67**	21.35	35.33	18.65	18.25	**22.56**
1 *(n=166)*	**11**	11	12	15	13	**51**	13	16	20	23	**72**
		21.57	23.53	29.41	25.49		18.06	22.22	27.78	31.94	
	24.44	24.44	14.46	9.87	18.84	**14.61**	14.61	10.67	6.43	16.79	**10.48**
>1 *(n=121)*	**5**	5	15	13	13	**46**	6	26	16	14	**62**
		10.87	32.61	28.26	28.26		9.68	41.94	25.81	22.58	
	11.11	11.11	18.07	8.55	18.84	**13.18**	6.74	17.33	5.14	10.22	**9.02**
MISSING	**32**					**25**					**40**
Total N= 1982	**45**	45	83	152	69	**349**	89	150	311	137	**687**
		12.89	23.78	43.55	19.77		12.95	21.83	45.27	19.94	

[1]Column percentages indicate the proportion of those with each MCI classification at each CDR_SoB level.

Row percentages indicate the proportion of those CDR_SoB level at each MCI category.

Table 5
Prevalence estimates for different MCI classifications

Sample frequency/proportions	Amnestic MCI	Expanded MCI	Cognitive Classification	CDR stage 0.5
n	45	349	687	546
% of 1982 (excluding moderate to severe impairment)	2.27	17.61	34.66	27.6
% of 2036 (total cohort)	2.21	17.14	33.74	26.82
POPULATION PREVALENCE:[1] weighted estimates *(95% confidence intervals)*				
Age 65-74 years	1.93 *(0.89 – 2.97)*	17.01 *(14.17 – 19.85)*	34.82 *(31.21 – 38.43)*	20.29 *(17.26 – 23.32)*
Age 75-84 years	2.22 *(1.26 – 3.19)*	17.96 *(15.45 – 20.47)*	34.93 *(31.81 – 38.05)*	27.84 *(24.93 – 30.75)*
Age 85+ years	3.19 *(1.41 – 4.98)*	19.00 *(15.03 – 22.96)*	37.47 *(32.52 – 42.41)*	39.64 *(34.74 – 44.54)*
Overall prevalence age 65+ years	**2.18** ***(1.51 – 2.85)***	**17.60** ***(15.83 – 19.38)***	**35.14** ***(32.90 – 37.38)***	**25.41** ***(23.45 – 27.37)***

[1] Weighting based on sampling scheme and US Census figures for the base population of the area.