

Mild Cognitive Impairment, Incidence, Progression, and Reversion: Findings from a Community-Based Cohort of Elderly African Americans

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Objective: To examine the long-term outcomes of community-based elderly African Americans by following their transitions from normal cognition to mild cognitive impairment (MCI) to dementia. **Methods:** Participants were from the community-based Indianapolis Dementia Project. A total of 4,104 African Americans were enrolled in 1992 or 2001 and followed until 2009 with regularly scheduled evaluation of cognitive assessment. A two-stage sampling was used at each evaluation to select individuals for extensive clinical assessment following the results of Stage 1 cognitive testing. Age- and gender-specific incidence, progression, and reversion rates for MCI were derived using the person-year method in a dynamic cohort and predicted probabilities from weighted multinomial logistic models of transitional probabilities among normal cognition, MCI, and dementia. **Results:** Annual overall incidence rate for MCI was 5.6% (95% confidence interval [CI]: 4.6%–6.6%). Annual progression rate from MCI to dementia was 5.9% (95% CI: 5.3%–6.5%), and annual reversion rate from MCI to normal was 18.6% (95% CI: 16.7%–20.4%). Both MCI incidence rates and MCI to dementia progression rates increased with age, whereas reversion rates from MCI to normal decreased with age. **Conclusion:** MCI progression to dementia was much more frequent in the older age groups than in younger participants where reversion to normal cognition is more common. Future research is needed to determine factors related to the heterogeneous outcomes in MCI individuals. (Am J Geriatr Psychiatry 2014; 22:670–681)

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INTRODUCTION

Dementia including Alzheimer disease (AD) affects millions of elderly Americans and is emerging as a major public health problem. In an effort to identify individuals at higher risk for dementia, the intermediate stage between normal cognition and dementia has been characterized as mild cognitive impairment (MCI).¹ Individuals in the MCI group were shown to progress to dementia at a higher rate than those with normal cognition, suggesting that some MCI individuals may be at the early stage of dementia. However, epidemiologic studies have also found that a substantial proportion of individuals with MCI revert to normal cognition, indicating a highly heterogeneous nature of the MCI group.²⁻⁷ Information on the epidemiology of individuals with MCI, including incidence, progression, and reversion, can help identify individuals at risk for dementia and lead to potential preventive measures in delaying conversion to dementia.

Previous studies on MCI have focused on separate cohorts of cognitive normal individuals at baseline for estimating incidence and cohorts of individuals with MCI at baseline for dementia progression. These studies have reported annual MCI incidence rates ranging from 0.85% to 12.2%^{3-5,7-19} and annual progression rates to dementia ranging from 0.9% to 15.3%.²⁰ Because MCI is known to be a transient state between normal cognition and dementia, it is essential to examine the incidence and progression of MCI simultaneously in population-based cohorts to appropriately account for transitions between normal cognition and MCI during follow-up. Few studies, if any, have examined the long-term outcomes of community-based elderly individuals by following their transitions from normal cognition to MCI and dementia. Various studies have indicated that African Americans are more likely than whites to have AD and other dementia.²¹ African Americans are also known to have higher prevalence of hypertension and diabetes than other ethnic groups, leading to potentially higher rates of MCI or MCI conversion rates.^{22,23} However, there has been little research on the natural history of MCI in African Americans. In this study, we report the incidence, progression, and reversion rates of MCI in an elderly African American cohort from the Indianapolis Dementia Project.

METHODS

Study Participants

Participants were from the Indianapolis cohort of the Indianapolis-Ibadan Dementia Project, a longitudinal study examining risk factors for dementia. Recruitment to the study was conducted at two time points. In the first recruitment in 1992, a cohort of African Americans aged 65 or older living in Indianapolis was enrolled in the study. The geographic target area used in the study consisted of 29 contiguous census tracts in which African Americans represented 80% of the population in the 1990 U.S. census. Interviewers went door-to-door to randomly sampled addresses to invite African Americans aged 65 years and over to participate. In 1992, 2,212 individuals were enrolled, whereas 249 (9.6%) refused and 121 (4.7%) were too sick to participate.

In 2001, the project enrolled additional community-dwelling subjects randomly selected from Medicare records who self-identified as African Americans and were at least 70 years old. The age cut-off for the 2001 cohort was chosen to maintain comparability with the 1992 cohort because the youngest participants in the 1992 cohort had since turned 70. Of 7,583 eligible individuals, interviewers were able to contact 4,433 by telephone or home visit. Of those contacted, 1,892 (43%) were enrolled, 2,020 (46%) refused, 369 (8%) were too ill, 100 (2%) were deceased, 54 (1%) had moved in nursing homes, and 14 (0.3%) were not African Americans.

The two cohorts were similar in basic demographics. Mean age during the 2001 evaluation was 77.4 (standard deviation [SD]: 6.0) for the 1992 cohort and 76.8 (SD: 5.6) for the 2001 cohort. The two cohorts also have similar gender distributions (65.3% women in the 1992 cohort and 65.0% in the 2001 cohort).²⁴ All participants agreed to undergo regular follow-up cognitive assessment and clinical evaluations.

The study was approved by the Indiana University-Purdue University of Indianapolis Institutional Review Board. All subjects enrolled provided informed consent. Details on the assembling of the original cohort and the enrichment cohort are described elsewhere.^{24,25}

Study Design

The Indianapolis-Ibadan Dementia Project is a prospective community-based study with a baseline

Progression and Transition Rates for MCI

evaluation followed by regular evaluations scheduled 2–3 years apart. Participants in the 1992 cohort were evaluated up to seven times, at 1992, 1995, 1998, 2001, 2004, 2007, and 2009. Participants in the 2001 cohort were evaluated up to four times, at 2001, 2004, 2007, and 2009.

A two-stage design was used at each evaluation with in-home cognitive and functional evaluations for all participants followed by a full diagnostic workup of selected participants based on the performance of Stage 1 cognitive tests. After each Stage 1 evaluation, study participants were divided into three performance groups (good, intermediate, and poor) based on their cognitive and functional scores obtained during the in-home assessment and changes in scores from previous evaluations.²⁶ Percentages sampled from each performance category were chosen to ensure that participants with the highest probability of dementia would be clinically assessed. All participants in the poor performance group were invited to be clinically assessed. Participants were randomly sampled from the intermediate performance group until 50% had clinical assessments and from the good performance group until 5% had clinical assessments.

Each clinically assessed participant received a diagnosis of normal, MCI, or dementia, with further subtypes for those diagnosed with dementia (see Clinical Evaluation, below). All individuals diagnosed as demented reached their endpoint in the study and were no longer followed. Participants who were diagnosed as MCI in a previous wave proceeded directly to the clinical assessment stage regardless of their first stage scores.

Cognitive Instruments

The Community Screening Interview for Dementia (CSID) was used during the first stage in-home assessment with a cognitive assessment of the study participant and an interview with a close relative evaluating the daily functioning of the participant. The CSID was developed by our group specifically for use in comparative epidemiologic studies of dementia in culturally disparate populations.^{27,28} The cognitive assessment in CSID evaluates multiple cognitive domains (language, attention and calculation, memory, orientation, praxis, comprehension, and motor response), and details of its content and development are described elsewhere.^{12–14}

Clinical Evaluation

Clinical evaluations included (1) a neuropsychological battery adapted from the Consortium to Establish a Registry of Alzheimer's Disease (CERAD),²⁹ (2) a standardized neurologic and physical exam and functional status review (Clinician Home-based Interview to assess Function),³⁰ and (3) a structured interview with a close relative adapted from the Cambridge Examination for Mental Disorders of the Elderly informant interview.^{31,32} After the second stage of evaluation, participants were diagnosed as having normal cognitive function, dementia, or MCI. Diagnosis was made in a consensus diagnostic conference of clinicians reviewing the CERAD neuropsychological test battery, the physician's assessment, the informant interview, and available medical records.

Dementia was diagnosed with both the *Diagnostic and Statistical Manual of Mental Disorders, Third Edition Revised*³³ and *International Classification of Diseases, 10th Revision*³⁴ criteria. AD was diagnosed using criteria proposed by National Institute of Neurological and Communicative Disorders and Stroke/Alzheimer's Disease and Related Disorders Association.³⁵ Criteria for MCI were as follows: informant-reported decline in cognition, clinician-detected impairment in cognition during the assessment, or cognitive test scores 1.5 SD below the mean of the normative reference sample and normal instrumental and basic activities of daily living (based on the informant interview).^{7,17,36,37}

Other Information

Demographic information including age, sex, and education were available on all study participants. Information was also collected on alcohol and smoking history on whether the participant ever consumed alcohol or smoked regularly. In addition, medical conditions that may affect cognitive function were collected at each of the evaluation times. In particular, medical history of coronary heart disease, cancer, diabetes, heart attack, hypertension, Parkinson disease, stroke, and depression was collected from self or informant reports as affirmative answers to whether the participants had ever been diagnosed or treated for these diseases.

Statistical Analyses

Comparisons of baseline demographic characteristics and medical history among participants with

incident dementia, those with MCI at any given time during the study, and participants who were not diagnosed as demented or MCI were conducted using χ^2 tests for categorical variables and analysis of variance for continuous variables for the 1992 cohort and the 2001 cohort separately.

To account for the two-stage sampling design, weighted multinomial logistic regression models were used to model the transitional probabilities of participants diagnosed with normal cognition at a particular evaluation transitioning into MCI or dementia or staying cognitively normal at the next

FIGURE 1. Flow chart of the number of study participants evaluated during follow-up.

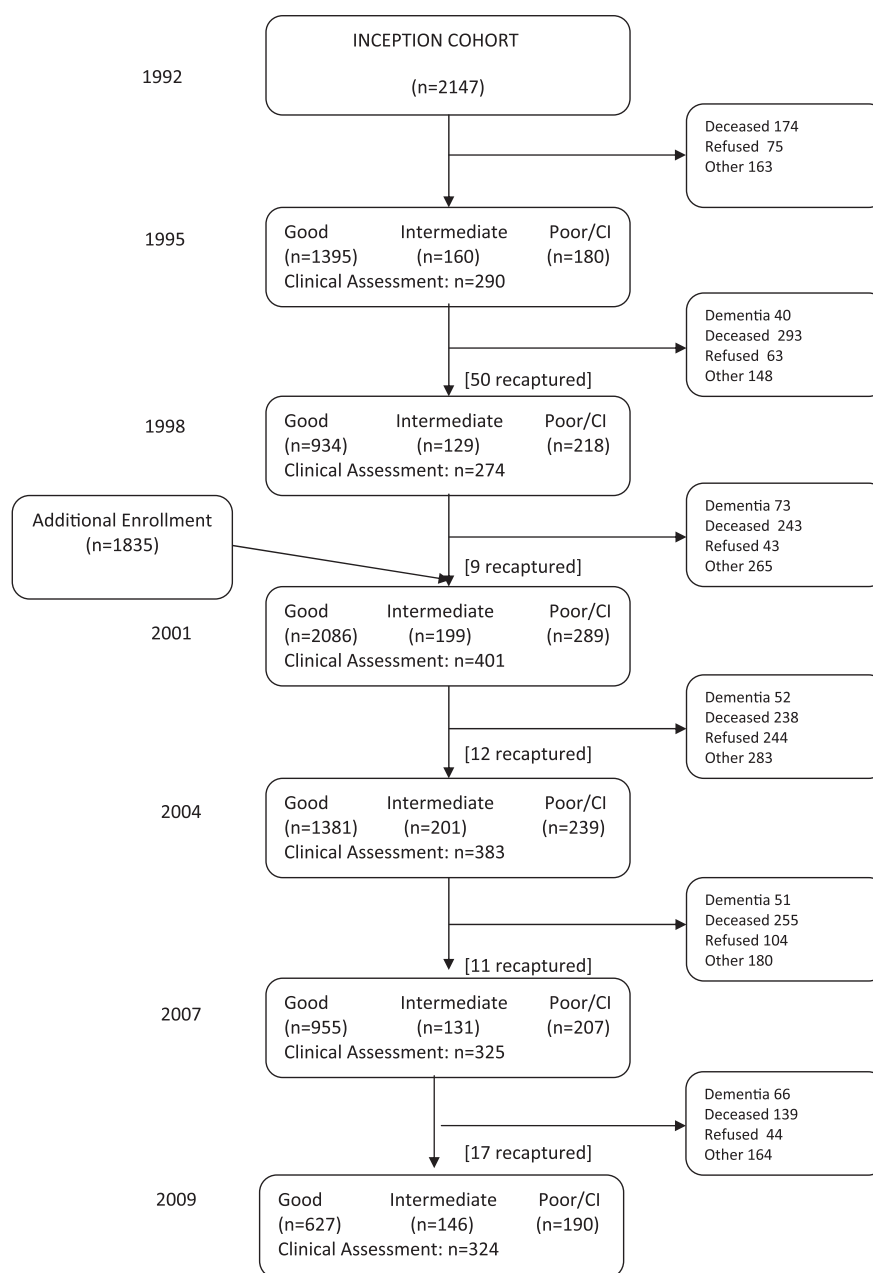


TABLE 1. Baseline Characteristics of Participants Enrolled in 1992 and 2001

Variables	1992 Cohort				p ^a	2001 Cohort				p ^b
	Overall (N = 2147)	Dementia (N = 157)	MCI (N = 327)	Normal (N = 1,663)		Overall (N = 1,835)	Dementia (N = 57)	MCI (N = 244)	Normal (N = 1,534)	
Age, yr, mean (SD)	74.3 (6.9)	76.4 (6.9)	75.3 (7.1)	73.9 (6.8)	<0.0001	77.2 (5.5)	79.3 (6.4)	78.8 (6.1)	76.9 (5.3)	<0.0001
Female	1,396 (65)	109 (69.4)	223 (68.2)	1,064 (64)	0.1669	1,201 (65.4)	48 (84.2)	149 (61.1)	1,004 (65.4)	0.0042
Years of education, mean (SD)	9.7 (3.1)	9.2 (3.3)	8.9 (3.1)	9.9 (3)	<0.0001	11.4 (2.7)	11.1 (2.6)	10.3 (3)	11.6 (2.6)	<0.0001
Alcohol	862 (40.5)	50 (32.1)	130 (40)	682 (41.4)	0.0758	648 (38)	16 (31.4)	89 (39.7)	543 (38)	0.5393
Smoking	1,396 (65)	83 (52.9)	214 (65.4)	1,099 (66.1)	0.0040	1,024 (56)	23 (41.1)	127 (52)	874 (57.2)	0.0228
Cognitive score, mean (SD)	30.7 (2.3)	30.3 (2.4)	29.5 (3.2)	30.9 (2)	<0.0001	30.9 (2.2)	30.7 (2.3)	29.9 (2.2)	31.1 (2.1)	<0.0001
Medical history										
CHD	602 (28)	42 (26.8)	92 (28.1)	468 (28.1)	0.9328	563 (30.7)	15 (26.3)	81 (33.2)	467 (30.5)	0.5298
Cancer	247 (11.5)	24 (15.3)	34 (10.4)	189 (11.4)	0.2689	306 (16.8)	5 (8.8)	30 (12.4)	271 (17.8)	0.0297
Diabetes	566 (26.4)	34 (21.7)	78 (23.9)	454 (27.3)	0.1649	533 (29.2)	17 (29.8)	70 (28.7)	446 (29.2)	0.9794
Heart attack	329 (15.4)	18 (11.5)	44 (13.5)	267 (16.1)	0.1782	254 (14)	6 (10.5)	42 (17.4)	206 (13.6)	0.2166
Hypertension	1,393 (64.9)	104 (66.2)	217 (66.4)	1,072 (64.5)	0.7519	1,370 (75.6)	38 (67.9)	177 (73.4)	1155 (76.2)	0.2583
Parkinson disease	21 (1)	1 (0.6)	4 (1.2)	16 (1)	0.8204	17 (0.9)	1 (1.8)	4 (1.6)	12 (0.8)	0.3445
Stroke	260 (12.1)	14 (8.9)	46 (14.1)	200 (12)	0.2611	277 (15.2)	12 (21.4)	61 (25.2)	204 (13.4)	<0.0001
Depression	169 (7.9)	9 (5.7)	33 (10.1)	127 (7.6)	0.1833	199 (10.9)	4 (7.3)	37 (15.5)	158 (10.4)	0.0423

Notes: Values are total number of incidences with percents in parentheses, except where otherwise noted. Participants diagnosed as incident dementia during the course of the follow-up were included in the dementia group. Participants diagnosed with MCI at any given time during the study without a dementia diagnosis were included in the MCI group. Participants who were not diagnosed as dementia or MCI were included in the normal group. CHD: coronary heart disease.

^ap Values were obtained by F tests with (2, 2,144) degrees of freedom from analysis of variance for continuous variables and by χ^2 tests with 2 degrees of freedom for categorical variables.

^bp Values were obtained by F tests with (2, 1,832) degrees of freedom from analysis of variance for continuous variables and by χ^2 tests with 2 degrees of freedom for categorical variables.

TABLE 2. Outcomes of Clinical Diagnoses During Two Consecutive Evaluations

Time 1	Outcomes	Outcomes at Time 2					Total
		Normal	MCI	Dementia	No CA	Deceased/Lost	
1992 (N = 2,147)	Normal	47	5	0	108	7/15	182
	MCI	17	33	17	0	15/24	106
	No CA	127	21	23	1,337	152/199	1,859
1995 (N = 1,695)	Normal	21	10	9	108	25/18	191
	MCI	7	10	9	0	20/13	59
	No CA	90	51	55	861	248/140	1,445
1998 (N = 1,204)	Normal	10	11	4	49	25/26	125
	MCI	5	8	11	13	21/14	72
	No CA	78	55	37	449	197/191	1,007
2001 (N = 2,520)	Normal	40	15	2	94	15/27	193
	MCI	20	43	22	16	16/37	154
	No CA	126	84	27	1,319	207/410	2,173
2004 (N = 1,768)	Normal	22	16	5	96	32/15	186
	MCI	19	30	32	8	30/25	144
	No CA	116	53	29	856	193/191	1,438
2007 (N = 1,226)	Normal	39	13	7	69	12/19	159
	MCI	11	30	13	6	22/17	99
	No CA	129	59	17	551	105/107	968

Notes: CA: clinical assessment.

follow-up. Weighted multinomial logistic regression models were also used to model the transitional probabilities of participants diagnosed as MCI at a particular evaluation reverting to normal cognition, staying as MCI, or progressing to dementia. The multinomial logistic models used transitional states as the outcome variables with age, gender, years of education, and performance groups from Stage 1 cognitive assessment as independent variables. The weights were the reciprocals of sampling probabilities for clinical assessment at each evaluation.

The person-years method was used to estimate age- and gender-specific annual transitional probabilities from normal cognition or MCI. For each individual in the study, we first determined the observation time contributed to a given age and gender group. We then summed individual observation times for a given age and gender group over all cohort members to obtain the total number of person-years of observation in that category. The total number of participants with a particular transition was estimated by summing predicted probabilities of the particular transition from the weighted multinomial models over all participants in the age and gender combination group. Because not all participants received clinical evaluation at the second stage, weighted multinomial models combining data from all evaluation waves and accounting for sampling selection were used to

provide estimated probabilities of participants diagnosed as normal cognition or MCI at each evaluation wave. Both the estimated cases of transition and the person-years at risk were further adjusted by these estimated probabilities for those not clinically evaluated in a previous wave.

The transition rates for a specific age and gender group were derived as the total estimated number of a particular transition divided by the total person-years at risk for the age and gender group. Because the transition rates were derived from complex models, we chose to use a nonparametric method, the jackknife variance estimator, for the derivation of standard errors of the rates. The jackknife variance estimator has been shown to be a consistent variance estimator for data from complex sampling³⁸ and is more stable than the bootstrap estimator.³⁹

Age-standardized overall transition rates were obtained by applying the estimated age- and gender-specific rates to the age and gender distribution of African American residents in Marion County (Indianapolis) observed in the 2000 census. The variance of the overall age-standardized rate was calculated as a weighted mean of the variances of the age- and gender-specific rates. Ninety-five percent confidence intervals (CIs) for the transition rates were constructed based on asymptotic normality of the estimates.

TABLE 3. Age- and Gender-Specific Annual Transition Rates (%) from Normal Cognition to MCI and from Normal Cognition to Dementia or AD

Sex	Age Group	Estimated Person-Year at Risk	Normal to MCI			Normal to Dementia			Normal to AD					
			Estimated Cases	Rate	95% CI	Estimated Cases	Rate	95% CI	Estimated Cases	Rate	95% CI			
Female	65-69	1,244	40	3.3	1.8	4.7	3	0.3	0.2	0.3	3	0.2	0.1	0.3
	70-74	3,106	93	3.0	2.1	3.9	12	0.4	0.3	0.5	10	0.3	0.3	0.4
	75-79	3,019	108	3.6	2.9	4.3	23	0.8	0.7	0.8	19	0.6	0.6	0.7
	80-84	1,763	75	4.2	3.3	5.2	22	1.2	1.1	1.4	19	1.1	1.0	1.2
	85+	961	51	5.3	3.5	7.0	26	2.7	2.3	3.0	23	2.4	2.1	2.7
Male	65-69	567	47	8.2	2.6	13.9	1	0.2	0.1	0.3	1	0.1	0.1	0.2
	70-74	1,325	104	7.9	3.6	12.1	5	0.4	0.2	0.5	3	0.3	0.2	0.3
	75-79	1,306	112	8.6	4.6	12.6	7	0.5	0.4	0.7	5	0.4	0.3	0.4
	80-84	550	55	9.9	5.7	14.2	4	0.8	0.6	1.0	3	0.6	0.5	0.7
	85+	261	30	11.6	6.6	16.6	3	1.3	0.9	1.7	3	1.0	0.8	1.2
Overall standardized				5.6	4.6	6.6		0.7	0.6	0.7		0.6	0.5	0.6

RESULTS

In the baseline evaluation of the 1992 cohort, 65 participants were diagnosed with dementia, leaving 2,147 participants free of dementia and eligible for continued follow-up evaluation. In the baseline evaluation of the 2001 cohort, 57 participants were diagnosed with dementia, leaving 1,835 participants eligible for continued follow-up evaluation. Thus, a total of 3,982 subjects were included in this analysis. The maximum follow-up time was 17.6 years for participants in the 1992 cohort and 8.5 years for those in the 2001 cohort. Mean follow-up time was 5.9 years (SD: 5.2) for participants in the 1992 cohort and 4.4 years (SD: 3.1) for the 2001 cohort. Figure 1 provides a schematic flow of the longitudinal study and information on loss to follow-up due to death, refusal, and other reasons at each evaluation.

Table 1 presents the baseline characteristics of study participants divided into three groups: those diagnosed with incident dementia during follow-up, those diagnosed with MCI at any time during the study, and those free of dementia or MCI during follow-up. In both cohorts, age, years of education, history of smoking, and baseline CSID scores were significantly different among the three groups. In addition, the 2001 cohort also showed significant difference in the proportions of female gender, cancer, stroke, and depression among the three groups, whereas no significant differences on these proportions were seen in the 1992 cohort.

Table 2 shows clinical outcomes during two consecutive evaluations. Few individuals transitioned from normal cognition to dementia between two consecutive evaluations, but a substantial number of normal participants and those without clinical assessments were diagnosed as MCI at the subsequent evaluation. Table 3 presents age- and gender-specific annual transition rates from normal cognition to MCI, dementia, or AD. For both men and women, the transition rates from normal cognition to MCI, dementia, or AD increased with age. For participants in age groups 75-79 and 80-84, men had significantly higher MCI incidence rates (i.e., transition rates from normal cognition to MCI) than women based on the non-overlapping CIs, whereas no significant gender difference was found for the other age groups. For older participants (age ≥80), women had significantly

TABLE 4. Age- and Gender-Specific Annual Transition Rates (%) from MCI to Normal Cognition or from MCI to Dementia or AD

Sex	Age Group	Estimated Person-Year at risk	MCI to Normal			MCI to Dementia			MCI to AD					
			Estimated Cases	Rate	95% CI	Estimated Cases	Rate	95% CI	Estimated Cases	Rate	95% CI			
Female	65–69	188	46	24.3	18.5	30.1	5	2.6	1.3	3.9	4	2.3	1.0	3.6
	70–74	638	129	20.2	15.7	24.7	22	3.4	2.4	4.4	19	3.0	2.0	4.1
	75–79	851	158	18.6	15.2	22.0	50	5.9	5.0	6.8	45	5.3	4.3	6.2
	80–84	731	107	14.6	12.1	17.1	63	8.7	7.5	9.8	58	7.9	6.7	9.1
	85+	599	57	9.6	7.2	12.0	84	14.1	10.0	18.2	79	13.2	8.7	17.7
Male	65–69	129	30	23.2	16.1	30.4	4	3.3	1.7	4.9	4	2.8	1.2	4.4
	70–74	402	71	17.8	12.0	23.5	20	5.0	3.2	6.8	17	4.3	2.5	6.1
	75–79	450	73	16.1	10.3	22.0	28	6.2	4.7	7.7	24	5.4	3.8	6.9
	80–84	258	32	12.3	7.4	17.3	25	9.7	7.9	11.5	22	8.6	7.0	10.3
	85+	168	14	8.2	3.9	12.5	25	15.0	10.5	19.5	23	13.7	9.1	18.4
Overall standardized				18.6	16.7	20.4		5.9	5.3	6.5		5.3	4.6	5.9

higher annual transition rates from normal cognition to dementia than men. The overall standardized annual incidence for MCI was 5.6% (95% CI: 4.6%–6.6%), and the overall standardized annual transition rate from normal cognition to dementia was 0.6% (95% CI: 0.6%–0.7%).

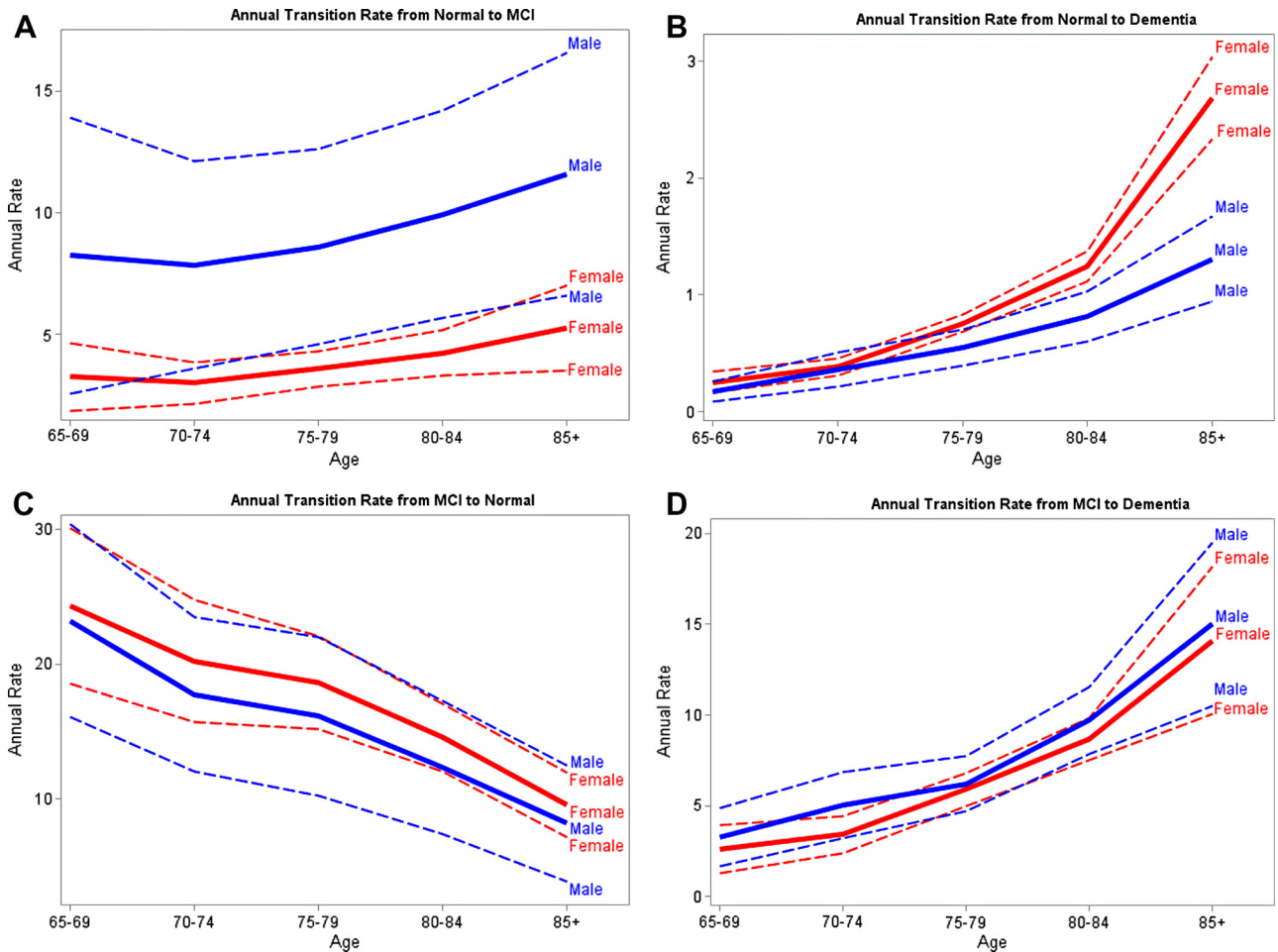
Table 4 presents age- and gender-specific annual transition rates from MCI to normal cognition, dementia, or AD. For the reversion rates from MCI to normal, a decreasing trend with age was seen where older participants were less likely to revert back to normal than younger participants. Progression rates from MCI to dementia or AD, on the other hand, increased with increased age. No gender difference was seen for any of the transitions from MCI. The overall standardized annual reversion rate from MCI to normal cognition was 18.6% (95% CI: 16.7%–20.4%). The overall standardized annual progression rate from MCI to dementia was 5.9% (95% CI: 5.3%–6.5%). Figure 2 displays these transitional rates.

DISCUSSION

Previous studies on MCI incidence have used the traditional closed-cohort approach by following only individuals with normal cognition at baseline to observe new MCI cases. Similarly, studies on MCI to dementia conversion were conducted by following only the group of MCI individuals at baseline and observing their progression to dementia. Given the transient nature of the MCI group, a closed-cohort approach could not appropriately adjust for transitions between normal cognition and MCI during the follow-up period. Our study uses a dynamic cohort approach to simultaneously estimate the transition probabilities among normal cognition, MCI, and dementia, thus allowing the modeling of dynamic changes in cognitive status of all individuals in the cohort.

Among community-based and clinic-based studies reporting incidence of MCI, annual incidence rates of MCI varied greatly, from 0.85% to 12.2%.^{3–5,7–19} Figure 3 presents annual incidence rates of MCI reported in previous studies and our results. The discrepancy in MCI incidence rates was largely attributed to differences in MCI definitions, which includes cognitive impairment no dementia, age-associated memory impairment, MCI, and amnesic

FIGURE 2. Age- and gender-specific annual transition rates and 95% CIs. Red lines represent estimated rates (solid lines) and CIs (dotted lines) in women. Blue lines represent estimated rates (solid lines) and CIs (dotted lines) in men.



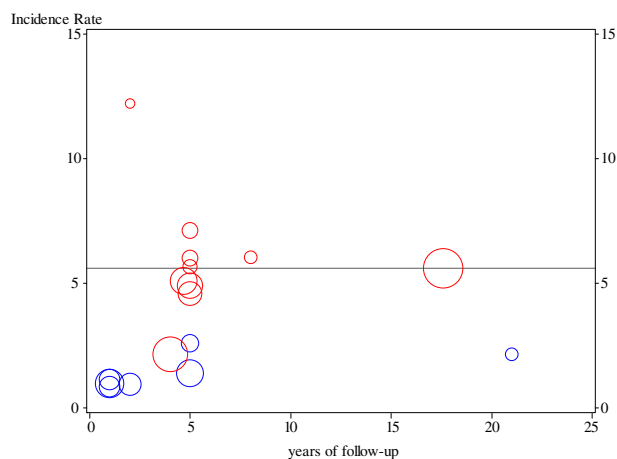
MCI, with amnesic MCI the most restrictive. Difference in rates may also reflect differences in age ranges, sample sizes, study populations, lengths of follow-up, and geographic regions. Among studies using similar diagnostic criteria to ours, there is a closer agreement in incidence rate estimates. Plassman et al.⁴⁰ reported annual cognitive impairment no dementia incidence of 6.04% with an 8-year follow-up, and the Canadian Study of Health and Aging reported annual incidence rates of 4.58% and 5.68%, respectively, for two populations followed for 5 years,^{18,19} all in close agreement with our overall annual incidence rate of 5.6%.

Progression rates from MCI to dementia have been reported much higher in clinic-based cohorts than in community-based cohorts.^{20,41} In community-based

studies, annual progression rates from MCI to dementia ranged from as low as 0.9%⁴² to as high as 15.3%.⁴³ A meta-analysis of 12 community-based MCI studies reported a pooled annual progression rate from MCI to dementia of 5.2% (95% CI: 2.9%–8.0%), which is very similar to the 5.9% annual progression rate found in this study, despite of the wide variability in MCI dementia progression rates seen in these studies.²⁰

Several epidemiologic studies have reported that 16%–50% of individuals with MCI reverted to normal cognition during various length of follow-up ranging from 3 to 10 years.^{2–5,7} Because some studies did not provide annual rates, it is difficult to directly compare our MCI reversion rates with these previous rates. Our analysis provides the longest follow-up in

FIGURE 3. Incidence rates for MCI reported in the literature and in this study (horizontal line). Blue circles represent incidence rates for amnesic MCI and red circles represent rates for all types of MCI. The sizes of the circles are proportional to study sample sizes.



studies reporting MCI reversion rates. In our cohort, about 18.6% of MCI individuals reverted to normal cognition annually. However, the reversion rates decreased greatly with increased age, and in the older age groups, more MCI individuals progressed to dementia or to AD than reverted to normal cognition.

Our results indicate a much higher transition rate to dementia from individuals with MCI than those with normal cognition, providing support to the notion that MCI as a group is at greater risk for dementia and should perhaps be targeted for early intervention to delay their transition into dementia. However, our results also highlight a cautionary note that a substantial proportion of individuals in the MCI group, especially those in the younger age groups, are more likely to revert back to normal cognition. Further research identifying predictive factors for progression or reversion in MCI individuals is needed to better define subgroups within MCI so that intervention could be delivered to those at the early stage of dementia and unnecessary treatment could be avoided in those who would revert to normal cognition.

Most previous studies either included only white participants or did not separately report rate estimates by racial groups. We found no MCI incidence, progression, or reversion rates for African Americans

in the literature other than a report of incidence estimates from our study with a shorter follow-up.⁷ In spite of the higher prevalence rates of AD and dementia in African Americans reported in some studies,²¹ our previous publications reported AD and dementia incidence rates comparable with those found in white populations.²⁶ Our results are similar to those reported from large community-based studies of whites suggesting little or no difference in MCI incidence or progression rates between African Americans and whites. This conclusion, however, needs to be verified by studies with sufficiently large samples of both African Americans and white participants to rule out potential biases due to differences among studies.

Our study has the strength of a long follow-up period in a large dynamic cohort of elderly African Americans. Identical diagnostic criteria were used throughout the entire study period, ensuring diagnostic consistency. In addition, random sampling was used for the selection of clinical assessment, thus permitting the use of weighted models to appropriately adjust for the sampling schemes and for the use of predicted probability of transitions.⁴⁴

Our study also has limitations. The study included only African American participants; thus, it is not known whether the rates reported here are generalizable to other elderly populations. We present transition rate estimates for all MCI individuals instead of by various MCI subtypes to preserve sufficient sample size for the modeling approach used in this analysis. Because not all study participants received the extensive clinical assessment at the second stage, our estimated transition rates may not be as accurate as if every participant had received the extensive clinical assessment. Nevertheless, the two-stage sampling design and our model-based approach have been used in many epidemiologic studies to estimate both prevalence and incidence rates^{25,26,45} and have been shown to provide unbiased and accurate estimates under various assumptions.⁴⁴

Our rate estimates could also be affected by selection biases from participants' refusal to enroll in the study, in particular, the relatively high refusal rate in the 2001 cohort. Despite differences in enrollment strategies, our previous analyses found no differences in prevalence rates of dementia or AD between the 1992 cohort and the 2001 cohort.²⁴ Our decision to estimate

transition rates using the combined cohorts provides a large sample size for stable rate estimates for age and gender subgroups. However, selection bias based on the differential refusal rates cannot be entirely ruled out. Another source of potential selection bias comes from refusals to the second-stage clinical assessment. Although our smoothed estimates provide unbiased rate estimates if refused participants differed in age, gender, education, or performance groups from those evaluated, potential bias may be introduced if the two groups differed on other characteristics not controlled in the logistic models.

In summary, in this elderly African American population, we found that MCI individuals converted to dementia at a higher rate than individuals with normal cognition. A substantial number of MCI individuals in the younger age groups reverted to normal cognition during follow-up. Both MCI incidence rates and MCI to dementia progression rates

increased with age, whereas reversion rates from MCI to normal decreased with age. Future research is needed to identify factors related to MCI progression and reversion.

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