Published in final edited form as:

J Am Geriatr Soc. 2011 January ; 59(1): 18–25. doi:10.1111/j.1532-5415.2010.03169.x.

Accelerated Weight Loss and Incident Dementia in an Elderly African-American Cohort

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Abstract

OBJECTIVES—To examine the association between changes in body mass index (BMI), dementia, and mild cognitive impairment (MCI).

DESIGN—Prospective observational study.

SETTING—Urban community in Indianapolis, Indiana.

PARTICIPANTS—Participants were African Americans aged 65 and older enrolled in the Indianapolis Dementia Project and followed through 2007. This analysis included 1,331 participants who did not have dementia at their first BMI measurement.

MEASUREMENTS—Cognitive assessment and clinical evaluations were conducted every other year to identify participants with dementia or MCI during 12 years of follow-up (mean follow-up 6.4 years). BMI measures; alcohol and smoking history; and medical conditions including history of cancer, hypertension, diabetes mellitus, heart attack, stroke; and depression were collected at each follow-up evaluation. Mixed-effect models were used to examine the differences in BMI between participants who developed dementia or MCI and those who did not, adjusting for covariates.

RESULTS—Mean BMI at baseline was 29.8 ± 5.7 for women and 28.3 ± 4.8 for men. Participants with incident dementia or MCI had greater decline in BMI than those without ($P=.02$ for dementia, $P=.04$ for MCI). BMI in participants with incident dementia, MCI, and normal

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Author Contributions: Study design: Gao, Hendrie, Unverzagt, Hall. Data acquisition: Hendrie, Unverzagt, Hake, Smith-Gambel, Hall. Data analysis and interpretation: Gao, Nguyen, Hendrie. Preparation of manuscript: Gao, Nguyen, Hendrie, Unverzagt, Hake, Smith-Gambel, Hall.

Conflict of Interest: The editor in chief has reviewed the conflict of interest checklist provided by the authors and has determined that the authors have no financial or any other kind of personal conflicts with this paper.

Sponsor's Role: The data used in this manuscript are from a NIH-funded study "Indianapolis-Ibadan Dementia Project." The sponsor played no role in the design, method, analysis, or preparation of the manuscript.

cognition did not differ 12 or 9 years before diagnosis, but 6 years before diagnosis, participants with incident dementia had significantly lower BMI than participants with normal cognition ($P=.03$), as did participants with MCI ($P=.006$).

CONCLUSION—Decline in BMI appears to be an early marker for dementia. There is a need for the close monitoring of weight loss in older adults.

Keywords

body mass index; dementia; mild cognitive impairment; African Americans

Obesity is associated with risk of diabetes mellitus, hypertension, and cardiovascular disease, conditions related to risk of dementia. There are studies confirming that midlife obesity is a risk factor for dementia,^{1,2} but studies on the relationship between body mass index (BMI) measured later in life and dementia have yielded inconsistent results, with some finding participants with higher BMI measures at greater risk³ and some at lower risk,^{4–6} and some finding no significant association with dementia.⁷ There are also reports that low BMI is associated with greater risk of dementia.⁵ A further complication to the relationship between BMI and dementia is that several studies have shown that weight loss may precede dementia diagnosis, suggesting that the timing of BMI measures from the time of dementia onset may determine the relationship between BMI and dementia risk.

Existing studies on BMI and dementia risk have not included substantial numbers of African-American participants, a group with the highest obesity rate of all ethnic groups in the United States.⁸ It is therefore important to assess whether changes in BMI are associated with risk of dementia in this particular population as has previously been shown in predominately white populations. Data from the Indianapolis cohort of the Indianapolis-Ibadan Dementia Project, including elderly community-dwelling African-American participants living in Indianapolis, were used. Participants completed repeated evaluations including height and weight measures, cognitive assessment, and clinical evaluation for the diagnosis of dementia or mild cognitive impairment (MCI). Analysis results on the association between repeated BMI measures and incident dementia and MCI diagnosis are reported.

METHODS

Study Participants

Participants were from the Indianapolis cohort of the Indianapolis-Ibadan Dementia Project, a longitudinal comparative epidemiological study examining risk factors for dementia and Alzheimer's disease. Recruitment into the study was conducted at two time points. In 1992, a cohort of African Americans aged 65 and older living in Indianapolis were enrolled in the study. Details on the assembling of this original cohort have been described elsewhere.⁹ In 2001, the project enrolled additional community-dwelling participants randomly selected from Medicare records who self-identified as African Americans and were aged 70 and older.¹⁰ All participants agreed to undergo follow-up cognitive assessment and clinical evaluations every 2 or 3 years. The Indiana University–Purdue University of Indianapolis institutional review board approved the study. All participants enrolled provided informed consent.

Clinical Evaluation

Participants in the 1992 cohort underwent five additional evaluations (1995, 1998, 2001, 2004, and 2007), and participants in the 2001 cohort received two additional evaluations (2004 and 2007). At each follow-up, participants were evaluated using a two-stage study

design. The first stage consisted of cognitive assessment and collection of potential risk factor information. This stage included an in-home interview using the Community Screening Interview for Dementia (CSI-D).¹¹ The CSI-D evaluates multiple cognitive domains (language, attention and calculation, memory, orientation, praxis, and comprehension and motor response) and includes a standardized interview of physical and social function from an informant if available. Based upon the cognitive assessment, participants were classified into three groups (good, intermediate, or poor performers). For cases in which there was not an informant, cognitive scores alone were used to determine performance group. The second stage used a full diagnostic clinical assessment, which was offered to all participants in the poor performance group and random samples of 75% of those with intermediate performance and 5% of those identified as good performers. The comprehensive cognitive and clinical assessment included a neuropsychological battery adapted from the Consortium to Establish a Registry of Alzheimer's Disease (CERAD),¹² a standardized neurological and physical examination and functional status review (The Clinician Home-based Interview to assess Function),¹³ and a structured interview with a close relative adapted from the Cambridge Examination for Mental Disorders of the Elderly informant interview.¹⁴ After the second stage of evaluation, participants were diagnosed into one of three mutually exclusive major cognitive diagnostic categories: 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. Clinicians were blinded to CSI-D scores and screening performance group. Dementia was diagnosed using International Classification of Diseases, 10th Revision¹⁵ and Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition¹⁶ criteria. Criteria for MCI were informant-reported decline in cognition, clinician-detected impairment in cognition on physical and neurological examination, or cognitive test scores 1.5 standard deviations below the mean of the normative reference sample,¹⁷ and normal instrumental and basic activities of daily living (based on informant interview and clinician examination). These MCI criteria are comparable with those advocated by the Mayo Clinic¹⁸ and the International Work Group on MCI¹⁹ and have been used in previous studies.^{20,21}

BMI Measures

Starting from the 1995 evaluation wave, height and weight measures were obtained during each in-home interview. For the original cohort enrolled in 1992, height and weight measures were obtained at the 1995, 1998, 2001, 2004, and 2007 evaluations. For those enrolled at 2001, height and weight measures were obtained at the 2001, 2004, and 2007 evaluations. BMI was calculated as weight in kilograms divided by height in meters squared.

Other Covariates

Demographic information including age, sex, and education were available on all study participants. Information was also collected on alcohol and smoking history. In addition, medical conditions that may affect BMI or cognitive function were collected at each evaluation. In particular, information was obtained on the history of cancer, hypertension, diabetes mellitus, heart attack, stroke, and depression.

Statistical Analyses

Because the analytical focus was on BMI change, repeated measures of BMI were used as the outcome variables. Three groups of participants were defined in the analysis. The first group consisted of participants with incident dementia diagnosed with dementia after the 1995 evaluation for those in the original cohort and after the 2001 evaluation for participants enrolled in 2001. A second group consisted of participants diagnosed with MCI at their last evaluation. The third group consisted of participants evaluated in 2007 during the in-home

cognitive assessment and determined to have good cognitive function. Participants with only one BMI measure or those diagnosed with dementia at or before their first BMI measures were excluded from the analysis.

To compare changes in BMI in people with dementia and MCI before they received a diagnosis with changes in BMI in people without dementia, the timing of the BMI measurements was aligned to an index time point defined to be the time of diagnosis for participants in the incident dementia group or the MCI group and the time of the 2007 evaluation for the participants with normal cognition. Therefore, all BMI measurements taken during the course of the study were aligned according to the number of years BMI was measured before the index time. In all of the statistical models, index time was coded as time 0. For example, a participant with BMI measured at 1995 and diagnosed with dementia in 2007 would have time coded as -12, indicating that BMI was measured 12 years before the dementia diagnosis.

Comparisons of demographic characteristics and medical history between the three groups of participants were conducted using chi-square tests for categorical variables and analysis of variance for continuous variables, followed by pairwise post hoc comparisons with significant overall differences. To control for potential confounding effects of chronic medical conditions on BMI change, the medical history of these conditions collected at index time as potential covariates was compared between the three groups of participants. Using the conditions collected at index time maximized potential effects caused by these conditions and may have yielded conservative estimates in the differences between the three groups of participants.

Mixed-effect models with random intercept and random slope for time were used to analyze the effect of each variable on BMI and BMI changes. Separate single-covariate mixed-effect models including one covariate, main effect of time and time squared, and an interaction term between the covariate and time were first explored. Variables that were significantly different between the three groups or significant in the single covariate BMI models were considered in a multivariate model. The final multivariate model included variables that had significant main effects or a significant interaction with time. Post hoc analyses examining BMI differences between the three groups at each of the five evaluation points were conducted using linear contrasts within the final mixed-effect model. The significance of a three-way interaction between baseline BMI level (obese, overweight, or normal weight), participant group (dementia, MCI, or normal cognition), and time to assess whether the relationship between BMI change and dementia or MCI was dependent on baseline BMI status was also examined. SAS version 9.1 was used for the analyses (SAS Institute, Inc., Cary, NC).

RESULTS

Of a total of 1,331 participants without dementia with baseline BMI available, 207 were diagnosed with dementia during the course of follow-up (46 in 1997, 47 in 2001, 49 in 2004, and 65 in 2007), 190 were diagnosed with MCI at their last follow-up evaluation (20 in 1997, 23 in 2001, 48 in 2004, and 99 in 2007), and 934 were found to have good cognitive function during the in-home cognitive assessment in 2007. Mean BMI at baseline in these 1,331 participants was 29.8 ± 5.7 for women and 28.3 ± 4.8 for men. At baseline 79% of women and 75% of men were overweight ($BMI \geq 25.0 \text{ kg/m}^2$), and 44% of women and 32% of men were obese ($BMI \geq 30.0 \text{ kg/m}^2$).

Summary statistics and participant characteristics in the groups with dementia, MCI, and normal cognition are presented in Table 1. The group with normal cognition had a slightly

longer follow-up time (6.5 years) than the group with dementia (6.1 years) or MCI (6.2 years), but they were not significantly different ($P=.16$). As expected, at index time (diagnosis time for participants with dementia and MCI, last follow-up evaluation for participants with normal cognition), participants with dementia and MCI were older, had fewer years of education, and were less likely to have hypertension and more likely to have had a stroke than participants with normal cognition. The MCI group had a lower proportion of women and those who never smoked than the groups with dementia and the normal cognition. The three groups did not differ significantly in alcohol consumption or history of cancer, diabetes mellitus, heart attack, or depression.

Table 2 presents results of the mixed-effect models containing a single covariate in each model with repeated BMI measures as outcomes. A significant main effect would indicate differences in BMI measures at index time between the levels defined by the covariate. Significant interaction between a covariate and time indicates differences in BMI changes over time between the levels defined by the covariate. Significant factors from Tables 1 and 2 were included in multivariate mixed-effect models to determine their respective contribution to BMI and BMI changes. The final mixed-effect model is presented in Table 3. Older participants, current smokers, and participants with dementia or MCI were found to have lower BMI at index time. Female participants had higher BMI at index time. In addition, the results show that women had greater decline in BMI than men. Participants with incident dementia or MCI had greater decline in BMI than those with normal cognition. There is also a significant quadratic time effect showing an umbrella trend in BMI in all participants. In Figure 1, predicted BMI values at different evaluation times were plotted for the three groups in women and men separately. It can be seen that, for women and men, BMI in the three groups was not very different early, but those with dementia and MCI showed a steeper decline in BMI than the group with normal cognition when BMI was measured closer to time of diagnosis. In addition, even those with normal cognition showed significant BMI decline over time, on average 0.38 points annually over the course of the 12-year follow-up.

The differences in BMI between the three groups at 12, 9, 6, and 3 years before diagnosis were further explored using linear contrasts generated from the final mixed-effect models. BMI in participants with incident dementia, MCI, and normal cognition did not differ 12 or 9 years before diagnosis, but at 6 years before diagnosis, participants with incident dementia had significantly lower BMI than participants with normal cognition ($P=.03$), as did participants with MCI ($P=.006$). The differences in BMI between participants with dementia or MCI and those with normal cognition were greater when the time of BMI measurement was closer to the time of diagnosis. BMI between the groups with dementia and MCI did not differ significantly at any time point.

To examine any potential modifying effect of baseline BMI status on the association between weight loss and dementia, another mixed-effect model including a three-way interaction between baseline BMI level (categorized as obese, overweight, or underweight), participant group (dementia, MCI, or normal), and time was used. There was no significant three-way interaction ($P=.56$) indicating a similar relationship between BMI decline and dementia and MCI status in participants who were obese, overweight, or normal weight at baseline. There were no underweight participants in this cohort.

In this study, all participants were followed until death, refusal to participate further, or dementia diagnosis. There were 655 participants with baseline BMI measures who were lost before the 2007 evaluation and whose last available evaluation indicated normal cognition. Table 4 compares these 655 participants with the 934 participants included in the group with normal cognition in the analysis. The mean follow-up time in the group lost to follow-up

(4.3 years) is significantly shorter than those of the other three groups included in the analyses (6.5 years for normal cognition, 6.1 years for dementia, and 6.2 years for MCI). A substantial proportion of this group (66.3%) was not followed because of death. Participants in this group were significantly younger and more likely to be male, smoke, and have less education, lower BMI, and a history of heart attack, but less likely to have hypertension than participants with normal cognition who were evaluated in the 2007 wave.

DISCUSSION

In this community-based elderly African-American cohort with up to 12 years of follow-up, it was found that participants with incident dementia or MCI had accelerated weight loss that was significantly different from weight loss of participants with normal cognition from as early as 6 years before diagnosis. This accelerated weight loss was observed in men and women.

These results are consistent with findings from several other studies reporting that weight loss precedes dementia diagnosis.^{4,22–25} These studies, despite varying sample sizes, differences in participant composition (community based or clinic based), and study design (prospective or case control), found significant difference in weight loss before dementia diagnosis. One of the studies found the difference in women but not in men,²² and another study included only men in the study sample,²⁴ but none included substantial numbers of African Americans. To the knowledge of the authors of the current study, this is the first to examine the relationship between BMI changes before dementia diagnosis in an African-American population with a substantial proportion of overweight and obese participants. It was found that, at baseline, 79% of the women and 75% of the men were overweight ($\text{BMI} \geq 25.0 \text{ kg/m}^2$) and that 44% of the women and 32% of the men were obese ($\text{BMI} \geq 30.0 \text{ kg/m}^2$). These rates are comparable to those reported in a representative national sample of African Americans aged 60 and older (overweight: 78.2% of women, 72.5% of men; obese: 50.5% of women, 38% of men).⁸ The high rates of obesity may contribute to high rates of comorbid conditions in this cohort, including more than 90% hypertension and more than 30% diabetes mellitus, although none of these comorbid conditions were found to be associated with weight loss in this cohort. Instead, it was found that accelerated weight loss was associated with dementia or MCI as early as 6 years before the clinical diagnosis even in participants who were overweight or obese.

The other unique feature of this study is that MCI participants were included in the analysis and weight loss was examined before the diagnosis of MCI. The results showed that participants with MCI had BMI decline similar to that of participants with dementia even when clinical evaluation at the last follow-up time determined these participants not to have dementia. MCI is a heterogeneous condition with variable outcomes, with not all progressing to dementia. Unfortunately, there was not a large enough sample size to further break down the MCI group to examine whether weight loss in participants with MCI who progress to dementia is different from weight loss in those who do not.

These results indicate that participants with normal cognitive function also experience age-related weight loss, an estimated annual decrease of 0.38 units in BMI. Age-related weight loss in participants with normal cognitive function was also reported in a clinic-based sample.²³ Gradual weight loss is believed to be associated with changes in the regulation of food intake during the aging process.²⁶ One possible cause for the decrease in food intake is an increase in the satiating effect of cholecystokinin with increase in age.²⁷ Potential roles of cytokines, interleukin-1, and interleukin-6 in weight loss in older adults have also been postulated.²⁸ These physiological changes in food intake regulation occur even in the presence of greater body fat and higher rates of obesity.²⁹

The explanation for the accelerated weight loss experienced by participants with dementia and MCI years before their diagnosis is not well understood. Weight loss in participants with dementia was sometimes attributed to the fact that these participants often forget to eat, creating a nutritional deficit leading to weight loss, but this is unlikely to be the reason for the additional weight loss in this cohort observed at least 6 years before diagnosis of dementia or MCI when these participants did not have symptoms of dementia. Some suspect that apathy and loss of initiative in the prodromal stage of dementia may contribute to the steeper weight loss observed in people with dementia.²² There is also a potential relationship between the loss of olfactory function and dementia that may contribute to the additional weight loss in the groups with dementia and MCI.³⁰ Further research to explore the biological mechanism underlying the association between weight loss and the onset of dementia is warranted.

There was a report from autopsy studies that decline in BMI several years before death was associated with Alzheimer's pathology regardless of dementia status.³¹ Although weight loss in people with dementia is well recognized, the fact that steeper decline in BMI was associated with greater Alzheimer's pathology even in participants with intact cognitive function at death seems to indicate that BMI changes may be linked to pathological changes in the brain before the appearance of dementia symptoms. Therefore, these results support the hypothesis that weight loss is an early marker for the manifestation of the dementia disorder, including the early stage of MCI.

There are currently conflicting findings in the literature on whether BMI obtained at a single time point is associated with risk of dementia or Alzheimer's disease. Results on midlife BMI are convergent in pointing to higher BMI being a significantly increased risk for dementia or Alzheimer's disease in late life, but a single BMI measure obtained in late life has yielded inconsistent results. Some studies report higher BMI as a risk factor for dementia,³ whereas others report higher BMI or even obesity as protective.^{4,32} Some of these studies, as part of a sensitivity analysis, excluded participants with dementia diagnosed within 2 to 3 years from baseline and still found a protective effect for higher BMI.³² As shown here, BMI decline in participants with dementia and MCI is likely to happen at least 6 years before clinical diagnosis. Hence, studies with relatively short follow-up may find baseline BMI measures protective. These results point to the importance of measuring and monitoring weight changes regularly in elderly participants because these changes may indicate a need for cognitive assessment.

The leading causes of weight loss in older adults are depression, cancer, and cardiovascular disease, in addition to dementia.³³ In the current sample, only dementia and cognitive impairment were found to be associated with accelerated weight loss, not the other conditions. This could be because participants with cancer, depression, or cardiovascular conditions were more likely to drop out during follow-up. The design of this study is to suit the trajectory of dementia onset, hence an assessment schedule of every two years. It is likely that cancer or cardiovascular disease may have developed more rapidly between evaluation times and been missed by the design. Therefore, the association between these conditions and weight loss may have been underestimated.

The finding that women had higher BMI than men at index time is consistent with previous report on sex differences in BMI.⁸ The finding that women had greater decline in BMI than men concurs with one previous report of sex difference in weight loss associated with dementia; a significant association between weight loss and dementia was reported in women, but not in men.²² The authors speculated that factors related to hormones may be involved in weight loss and dementia.

The current study had a number of strengths. First, the study participants represented a well-characterized community-based random sample of elderly African Americans. The findings indicate that significant weight loss was associated with dementia and MCI despite the higher proportions of obese and overweight participants in this population than reported in previous studies. Evaluations and diagnosis of dementia and MCI were conducted regularly, prospectively, and carefully using the same diagnostic criteria over the course of follow-up. Second, BMI and other covariate information were also collected prospectively at regular time intervals, reducing potential recall bias. Third, there was long follow-up on the majority of the study participants, allowing changes in BMI before the diagnosis of dementia or MCI to be characterized in this cohort.

This study also has important limitations. Measurement of BMI may not accurately reflect changes in body composition in older adults, because aging is associated with an increase in fat mass but a decrease in lean mass. Although waist circumference measures were taken in the 2007 wave of evaluation, repeated measures of waist circumferences were not available as they were for BMI. Therefore, it is not clear whether the accelerated weight loss before dementia or MCI diagnosis can be attributed to the loss of lean muscle. In addition, information was not available on whether weight loss that participants experienced was voluntary, such as that achieved through diet or exercise, so it was not possible to separately ascertain the potential effect of intended weight loss (or weight gain) on dementia or MCI.

In summary, this community-based elderly African-American cohort with a substantial number of overweight and obese participants found that participants with incident dementia or MCI exhibit greater weight loss approximately 6 years before diagnosis than those who had normal cognition during the follow-up period. These results support the hypothesis that decline in BMI is an early marker for dementia and point to the need for the close monitoring of weight loss in older adults.

Acknowledgments

The research is supported by National Institutes of Health (NIH) Grant R01 AG09956.

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Figure 1.
Predicted mean body mass index levels over time according to and diagnosis group.
MCI=mild cognitive impairment.

Table 1

Participants' Characteristics of Participants with Incident Dementia (D), Mild Cognitive Impairment (MCI), and No Dementia (ND)

Characteristic	D (n = 207)	MCI (n = 190)	ND (n = 934)	P-Value	P-Value DvsND	P-Value MCI vs ND	P-Value D vs MCI
Follow-up, years, mean ± SD	6.1 ± 3.3	6.2 ± 3.4	6.5 ± 2.8	.16	—	—	—
Age, mean ± SD	84.0 ± 6.6	83.4 ± 6.1	81.6 ± 4.7	<.001	<.001	<.001	.21
Female, N (%)	149 (72.0)	120 (63.2)	682 (73.0)	.02	.76	.006	.06
Education, years, mean ± SD	10.0 ± 3.2	10.3 ± 2.9	12.0 ± 2.4	<.001	<.001	<.001	.32
BMI, kg/m ² , mean ± SD							
Women	26.4 ± 7.0	26.2 ± 5.7	28.4 ± 5.7	—	—	—	—
Men	26.4 ± 3.5	26.6 ± 6.0	27.5 ± 4.9				
Drink alcohol, n (%)				.14	—	—	—
Never	78 (37.7)	60 (31.6)	318 (34.1)				
Current	22 (10.6)	30 (15.8)	164 (17.6)				
Past	107 (51.7)	100 (52.6)	452 (48.4)				
Smoker, n (%)				.009	.15	.003	.30
Never	91 (44.0)	70 (36.8)	412 (44.1)				
Current	28 (13.5)	33 (17.4)	86 (9.2)				
Past	88 (42.5)	87 (45.8)	436 (46.7)				
History of, n (%)							
Cancer	41 (19.8)	37 (19.6)	222 (23.8)	.27	—	—	—
Hypertension	186 (90.3)	171 (91.0)	882 (95.5)	.003	.003	.01	.82
Diabetes mellitus	62 (30.0)	67 (35.3)	336 (36.0)	.26	—	—	—
Heart attack	68 (32.9)	65 (34.2)	256 (27.4)	.08	—	—	—
Stroke	65 (31.4)	53 (27.9)	158 (16.9)	<.001	<.001	<.001	.44
Depression	47 (22.7)	40 (21.1)	156 (16.7)	.07	—	—	—

Information was collected at the time of diagnosis for participants with dementia and MCI and at the 2007 evaluation for participants with normal cognition.

SD = standard deviation; BMI = body mass index.

Table 2

Univariate Associations Between Covariate Measures and Repeated Body Mass Index Measurement over Time Using Mixed-Effect Modeling

Variable	Parameter Estimate (Standard Error Estimate) <i>P</i> -Value	
	Main Effect	Interaction with Time (Slope)
Age	−0.200 (0.029) <.001	−0.012 (0.003) <.001
Female	0.837 (0.347) .02	−0.113 (0.031) <.001
Education	−0.028 (0.057) .63	0.009 (0.005) .07
Alcohol		
Current	−0.482 (0.304) .11	−0.005 (0.038) .89
Past	−0.361 (0.288) .21	−0.009 (0.031) .77
Never	Reference	Reference
Smoking		
Current	−1.291 (0.355) <.001	−0.018 (0.040) .65
Past	−0.365 (0.301) .22	0.015 (0.030) .60
Never	Reference	Reference
History of		
Cancer	−0.020 (0.235) .93	0.0048 (0.035) .89
Hypertension	−0.143 (0.283) .61	−0.102 (0.040) .01
Diabetes mellitus	0.610 (0.214) .004	0.049 (0.030) .10
Heart attack	0.152 (0.212) .47	−0.003 (0.030) .91
Stroke	−0.062 (0.229) .79	−0.021 (0.039) .60
Depression	0.207 (0.233) .37	0.007 (0.039) .85

Each model includes one covariate, main effect of time and time squared, and an interaction term between the covariate and time.

Table 3

Multivariate Associations Between Covariate Measures and Repeated Body Mass Index Measures over Time Before Diagnosis of Dementia or Mild Cognitive Impairment (MCI) Using Mixed-Effect Modeling

Measure	Parameter Estimate (Standard Error Estimate)	P-Value
Main effect		
Age	−0.163 (0.028)	<.001
Female	0.827 (0.345)	.02
Smoking		
Current	−1.172 (0.297)	<.001
Past	−0.363 (0.277)	.19
Never	0	
Group		
Dementia	−1.453 (0.433)	.001
MCI	−1.723 (0.447)	<.001
Normal	0	
Time	−0.379 (0.034)	<.001
Time ²	−0.028 (0.002)	<.001
Interaction with time		
Female × time	−0.119 (0.031)	<.001
Group × time		
Dementia	−0.091 (0.040)	.02
MCI	−0.086 (0.041)	.04
Normal cognition	0	

Table 4

Comparisons of Participant Baseline Characteristics Between Subjects with Normal Cognition Who Were Followed to the 2007 Evaluation (n = 934) and Subjects Who Were Lost to Follow-Up Before 2007 and Had Normal Cognitive Function at Their Last Evaluation (n = 655)

Characteristic	Evaluated in 2007 (n = 934)	Lost Before 2007 (n = 655)	P-Value
Follow-up, years, mean $\pm$ SD	6.5 $\pm$ 2.8	4.3 $\pm$ 2.5	<.001
Age, mean $\pm$ SD	81.6 $\pm$ 4.7	79.2 $\pm$ 5.6	<.001
Female, n (%)	682 (73.0)	411 (62.8)	<.001
Education, years, mean $\pm$ SD	12.0 $\pm$ 2.4	11.0 $\pm$ 2.7	<.001
Body mass index, mean $\pm$ SD			
All subjects	29.8 $\pm$ 5.5	28.3 $\pm$ 5.9	<.001
Women	30.3 $\pm$ 5.7	29.1 $\pm$ 6.3	.002
Men	28.6 $\pm$ 4.6	27.0 $\pm$ 4.7	<.001
Drink alcohol, n (%)			.06
Never	337 (36.2)	219 (33.4)	
Current	219 (23.5)	133 (20.3)	
Past	376 (40.3)	303 (46.3)	
Smoker, n (%)			<.001
Never	414 (44.6)	203 (31.0)	
Current	135 (14.6)	149 (22.8)	
Past	379 (40.8)	303 (46.3)	
History of, n (%)			
Cancer	144 (15.6)	112 (17.2)	.39
Hypertension	682 (77.9)	466 (73.4)	.04
Diabetes mellitus	239 (25.7)	185 (28.3)	.24
Heart attack	165 (17.7)	167 (25.5)	<.001
Stroke	93 (10.0)	77(12.0)	.25
Depression	80 (8.6)	53 (8.1)	.72

SD = standard deviation.