American Journal of Epidemiology
Vol. 137, No. 8

Printed in U.S.A.

Relation of Smoking and Low-to-Moderate Alcohol Consumption to Change in Cognitive Function: A Longitudinal Study in a Defined Community of Older Persons

Liesi E. Hebert,[1,2] Paul A. Scherr,[3] Laurel A. Beckett,[1] Marilyn S. Albert,[4] Bernard Rosner,[5] James O. Taylor,[5] and Denis A. Evans[1]

To determine whether smoking habits and alcohol consumption are related to changes in cognitive function, the authors conducted a prospective, community-based study of persons aged 65 years and over in East Boston, Massachusetts. In 1982 and again in 1985, the subjects were given three brief tests of cognitive function: immediate memory, digit span, and a mental status questionnaire, which primarily assessed orientation. The 1,201 individuals who performed well in 1982 were included in linear regression analyses of 3-year change in performance, adjusted for age, sex, education, and income. Relative to nonsmoking, current smoking, past smoking, and pack-years were not significantly related to change in immediate memory. None was significantly related to change in orientation. Only pack-years was significantly related to normal change score in digit span (normal change score change per unit of predictor = 0.001, 95% confidence interval 0.0003–0.002). Low-to-moderate alcohol consumption during the month preceding baseline testing was not significantly related to a subsequent 3-year change in performance in two of the three tests. However, people who consumed a very small amount of alcohol had a normal change score that was 0.088 (95% confidence interval 0.015–0.160) better for digit span than did nondrinkers. This study provides evidence that the reported levels of smoking and alcohol use among older persons are not consistent or substantial predictors of the longitudinal change in cognitive function observed in a community. *Am J Epidemiol* 1993;137:881–91.

aging; alcohol drinking; Alzheimer's disease; cognition; prospective studies; longitudinal studies; risk factors; smoking

Consumption of large quantities of alcohol has been linked to impaired cognitive function (1), but studies of moderate use have reported conflicting results (2). A possible link between smoking and cognitive impairment has also been suggested (3). To our knowledge, however, no longitudinal studies involving structured tests of change in cognitive function among large populations of older persons have been reported.

Received for publication May 6, 1992, and in final form November 24, 1992.

Abbreviation: CI, confidence interval

[1] Center for Research on Health and Aging, Rush-Presbyterian-St. Luke's Medical Center, Chicago, IL.

[2] Department of Health Policy and Management, Harvard University School of Public Health, Boston, MA.

[3] Aging Studies Branch, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control, Atlanta, GA.

[4] Departments of Psychiatry and Neurology, Massachusetts General Hospital, and Department of Psychiatry, Harvard Medical School, Boston, MA.

[5] Channing Laboratory, Department of Medicine, Brigham and Women's Hospital, and Department of Medicine, Harvard Medical School, Boston, MA.

Reprint requests to Dr. Liesi E. Hebert, Center for Research on Health and Aging, Rush-Presbyterian-St. Luke's Medical Center, 1653 Congress Parkway, Chicago, IL 60612.

Supported by cooperative agreement AHO6789 and contracts NO1-AG-1-2106 and NO1-AG-O-2107 from the National Institute on Aging, National Research Service Award training grant T32-ESO7O69 from the National Institute of Environmental Health Sciences, and the CLINFO data management and analysis system supported by Clinical Research Center grant M01 RR 02635.

This paper reports the relation of smoking habits and alcohol use to changes in performance on structured tests of cognitive function over a 3-year period in a defined community of older persons. Our method of investigating these relations enabled us to ascertain exposures and end points of interest uniformly.

MATERIALS AND METHODS

Population

The study was conducted in East Boston, Massachusetts. This geographically defined, urban, working-class community is one of four centers of the Established Populations for Epidemiologic Studies of the Elderly program of the National Institute on Aging. Beginning in 1982, noninstitutionalized persons aged 65 years or over were interviewed in their homes. A total of 3,809 persons (85 percent of the age-eligible population) participated in the baseline study (4). Three years later, 93 percent of the survivors participated in a second home interview. Each interview included structured tests of several areas of cognitive function. Information about alcohol and cigarette use was obtained in the baseline interview.

Cognitive function tests

At each interview, cognitive function was assessed by conducting structured performance tests of immediate memory, digit span, and orientation. To test memory, the interviewers read a brief story composed of three short sentences, each of which contained two ideas. Participants were asked to retell the story immediately and were scored according to the number of the specified ideas they remembered (4, 5). Digit span was tested by asking the participant to repeat immediately a series of five digits. Those unable to repeat five digits were asked to repeat a four-digit series. The series of digits were selected from those used in the Wechsler Adult Intelligence Scale (6). A score of two was given if the five-digit series was repeated correctly, a score of one was given if the four-digit series was repeated correctly, and a score of 0 was given if neither series was repeated correctly. In the orientation test, participants responded to nine questions selected from a previously used mental status questionnaire (7) that included questions about the date, day of the week, current and previous US presidents, and serial subtraction. Participants were scored according to the number of questions answered correctly.

To focus on persons with onset of declining cognitive function, to assure the quality of the exposure data, and to ensure that the same persons were included in analyses for each test, we restricted the analyses of change to people who performed well on all three tests during the baseline interview and who completed all three tests during the second interview. People with the following baseline scores were included: four or higher (of a possible six) on the immediate memory test; seven or higher (of a possible nine) on the orientation test; and two (of a possible two) on the digit-span test. Of the 3,300 people who completed the baseline tests, 1,588 scored well on all three tests. In the 3-year interval between surveys, 159 of those people died. Of the remainder, 1,201 completed all of the tests during the second interview and were included in this study. Comparison of participants with people who died in the interval and people who refused a follow-up interview yielded no significant differences in smoking habits, alcohol use, or baseline cognitive performance.

Predictors

Data on smoking habits and use of alcohol were obtained at the baseline interview. This provided exposures measured before the period when decline was measured. Smoking information was summarized as smoking status (current smoker, ex-smoker, or never smoker), current number of packs of cigarettes smoked per day (usual number for ex-smokers), number of years smoked, and number of pack-years.

To determine alcohol use, participants were asked if they had consumed any alcohol in the previous year. Those who did were

asked separate questions about the consumption of beer, wine, and liquor. The amounts of each beverage consumed over the previous month were combined to form a summary measure representative of the total ounces of alcohol consumed per day (8). Consumption was grouped in four categories: none in the previous year; less than 0.5 ounce (15 ml) per day; 0.5 ounce to less than 1 ounce (15 ml to less than 30 ml) per day; and 1 or more ounces (30 ml or more) per day. In supplementary analyses, the number of ounces consumed per day was considered a continuous variable.

Demographic variables were ascertained during the baseline interview and considered possible confounders. These variables included age, sex, years of formal schooling, income, and usual occupation. Current annual household income was grouped into six categories: less than $5,000; $5,000 to less than $7,000; $7,000 to less than $10,000; $10,000 to less than $12,500; $12,500 to less than $15,000, and $15,000 or more. Occupation was grouped into four categories by census code: professional or manager; clerical worker; housewife; and other. In addition, occupations were classified by using the modified Duncan Socioeconomic Index of occupational prestige (9).

The presence of chronic conditions was determined during the baseline interview by self-report of stroke, heart attack, cancer, diabetes, or high blood pressure. These were summarized as a single indicator variable for the presence of any chronic condition.

Statistical methods

Analyses of change in test scores over time must consider baseline scores. Because of the limited scoring range of each of the cognitive tests, the range of a possible change in score was limited and was different for each baseline score. For example, people who achieved the maximum score on the baseline test could either remain the same or decline, whereas those who scored 1 or 2 below the maximum could improve, remain the same, or decline. The distribution of changes in immediate memory score is shown in figure 1 for each baseline score. To control for the effects of these different distributions and to transform the scores to a more normal distribution, the normal scores transformation (10) was applied separately within each stratum of baseline score. For each baseline score, the changes in score were ranked so that those who declined the most had the lowest ranks and those who improved the most had the highest ranks. Each rank was then transformed into the score to which the rank corresponded in a normal distribution, with a mean of 0 and a standard deviation of 1. A person at the median would have a normal score of 0, and a person who performed 1 standard deviation worse than the median would have a normal score of -1.0. A person who achieved a score 1 standard deviation better than the median would have a normal score of 1.0. These normal scores were used in subsequent analyses. For each cognitive function test, linear regression analysis was used to examine the effects of smoking and alcohol use on the normal score, controlled for possible confounders. Because the correlates of change in cognitive function have not been established, stepwise linear regression was used to determine which of the demographic variables, in addition to age and sex, were related to changes in performance for each test. Education and income were significant predictors of each test, but neither grouping of occupation added predictive power to any of the three tests. Therefore, analyses of the effects of smoking and alcohol were controlled for age, sex, education, and income. To test for possible confounding by baseline health status, we included an indicator for the presence of any of chronic conditions in an additional set of regression analyses.

RESULTS

Table 1 shows the age and sex distribution of the subjects in these analyses. There are substantial numbers in all but the oldest age group. The small number of people over age 80 reflects the small proportion of that group who performed well on all three baseline tests.

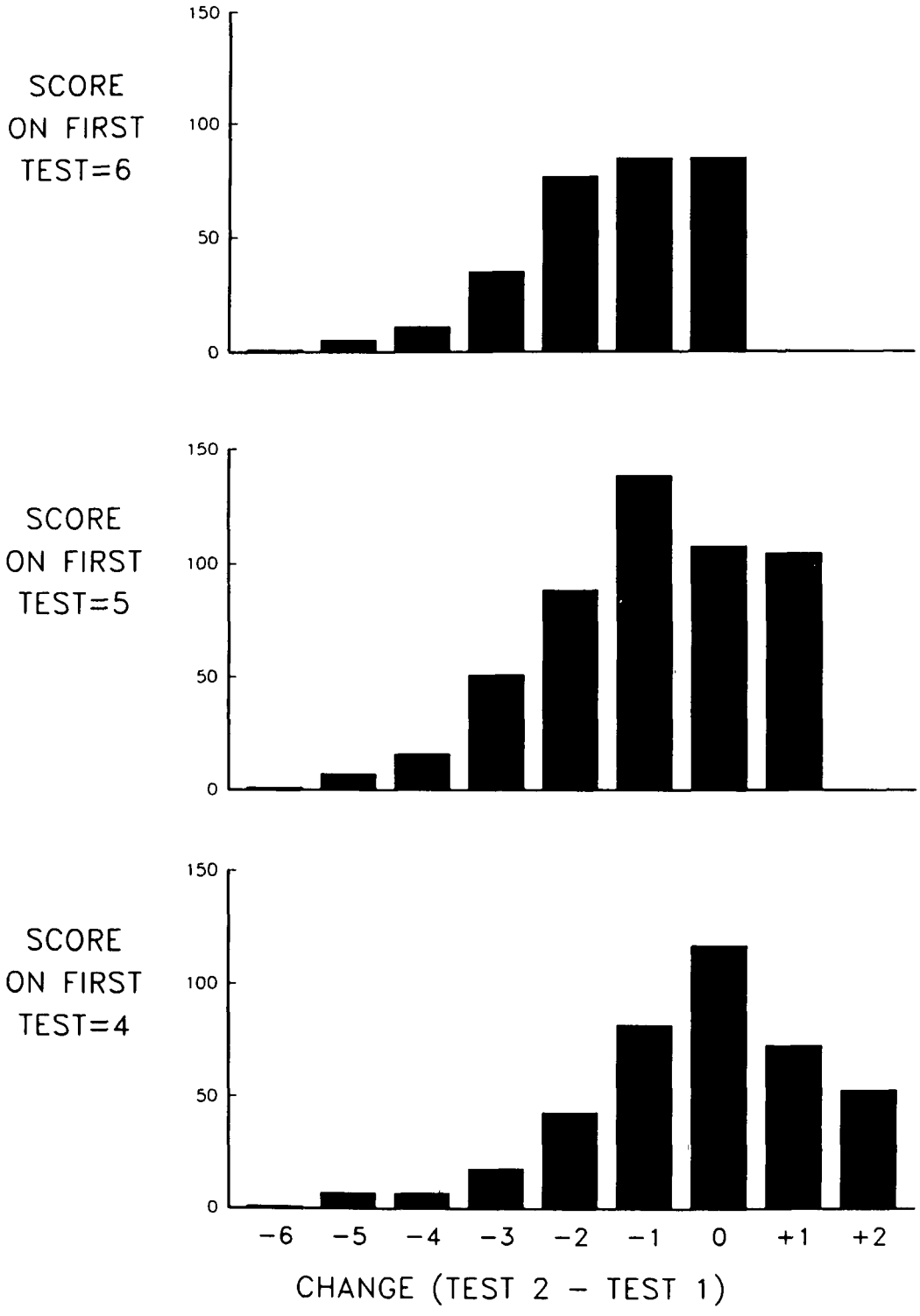

FIGURE 1. Distribution of 3-year changes in immediate memory, by score on the baseline memory test, East Boston, Massachusetts, 1982–1985.

TABLE 1. Number and percent of study subjects aged 65 years and older, by age and sex, East Boston, Massachusetts, 1982–1985

Age (years)	Men		Women	
	No.	%	No.	%
65–69	214	46.9	343	46.0
70–74	152	33.3	232	31.1
75–79	69	15.1	117	15.7
≥80	21	4.6	53	7.1
Total*	456	99.9	745	99.9

* Total does not add to 100% because of rounding.

TABLE 2. Distribution of smoking and alcohol consumption among study subjects aged 65 years and older, East Boston, Massachusetts, 1982–1985

	Men (%)	Women (%)
Alcohol consumption		
None in past year	13.9	28.6
Very light (>0 to <0.5 ounce/day)*	45.5	61.3
Light (0.5 to <1 ounce/day)	14.6	6.9
Moderate (≥1 ounce/day)	26.0	3.2
Smoking		
Never smoker	27.8	61.8
Former smoker (pack-years)		
<30	14.0	10.4
30 to <60	14.0	3.9
≥60	18.7	3.6
Current smoker (pack-years)		
<30	4.7	8.5
30 to <60	12.4	8.9
≥60	8.4	2.8

* 1 ounce = 30 ml.

Alcohol use

A larger percentage of men than of women were drinkers (table 2). Among drinkers, men consumed larger quantities of alcohol than did women. To examine crude associations, the subjects were divided into 18 age-sex-alcohol strata. Within age-sex strata, there was no consistent relation between the amount of alcohol consumed and mean normal change scores for any of the three cognitive tests (table 3).

In linear regression analyses, controlling for smoking and for all confounders simultaneously, the normal change score for the test of orientation indicated no significant relation with any level of alcohol use (table 4). For the digit-span test (table 5), people who consumed less than 0.5 ounce (15 ml) of alcohol per day had a significantly better normal change score (0.088; 95 percent confidence interval (CI) 0.015–0.160) than did people who never drank, while people who drank more than 0.5 ounce per day had scores that were not significantly different from those of nondrinkers. In contrast, on the immediate memory test (table 6), the group who drank more (1 ounce (30 ml) or more per day) had nearly significantly better normal change score than did nondrinkers (0.181; 95 percent CI -0.015 to 0.377). When ounces of alcohol consumed was considered as a continuous variable, there was no significant relation with any of the three tests.

Smoking

A larger proportion of men than of women were former smokers (46.7 percent vs. 17.9 percent) (table 2). Current smoking levels decreased with increasing age. Only 8 percent of women and 18 percent of men over age 75 years were current smokers. Many smokers and ex-smokers had smoked for more than 30 years, however.

Crude associations were examined by dividing subjects into 18 age-sex-smoking strata (table 7). In all but one age-sex group, current smokers appeared to have better normal change scores for immediate memory than did others over the 3-year interval, as shown by the larger positive values. There were no consistent relations within age-sex groups between smoking and normal change scores for the orientation or digit-span test.

TABLE 3. Mean normal change scores,* by alcohol consumption, age, and sex, among subjects aged 65 years and older, East Boston, Massachusetts, 1982–1985

Sex and age (years)	No.†	Drinking status‡		
		Nondrinker	<0.5 ounce/day	≥0.5 ounce/day
		Orientation test		
Men				
65–69	214	0.12	0.20	0.22
70–74	152	0.03	0.01	−0.07
≥75	87	−0.17	−0.03	−0.12
Women				
65–69	342	0.05	0.29	0.11
70–74	232	−0.03	0.05	0.08
≥75	170	−0.19	−0.13	−0.30
		Digit-span test		
Men				
65–69	214	0.07	−0.01	0.07
70–74	152	−0.11	−0.04	−0.17
≥75	87	−0.20	−0.12	0.08
Women				
65–69	342	−0.10	0.07	−0.05
70–74	232	0.00	0.02	0.02
≥75	170	−0.17	−0.06	−0.08
		Immediate memory test		
Men				
65–69	214	0.37	0.07	0.24
70–74	152	0.14	−0.05	−0.11
≥75	87	−0.44	−0.12	0.14
Women				
65–69	342	0.14	0.30	0.27
70–74	232	0.01	0.03	0.10
≥75	170	−0.15	−0.02	−0.04

* Normal scores transformation of change in test result ranked within each level of baseline test result, e.g., 0 = median test result; 1 = 1 standard deviation better than median result.
†Numbers do not always add to totals in table 1 because of missing data
‡ 1 ounce = 30 ml.

Linear regression analyses, controlling simultaneously for alcohol use and demographic variables, were used to determine the relation between smoking and normal change scores. For orientation and immediate memory, there was no significant association with current smoking, former smoking, or pack-years (tables 4 and 6). For the digit-span test, an increase in pack-years was associated with a small significant improvement of 0.001 (95 percent CI 0.0003–0.002) in normal change score for each additional pack-year (table 5). This was counterbalanced, however, by a nonsignificant decrease in scores for both current and former smokers.

To determine the effect of using other measures of smoking, additional models were tested, substituting packs of cigarettes smoked per day and then years of smoking for pack-years. Each measure of smoking exposure was treated as a continuous variable and then as a categorical variable. The results of all five models were similar to those presented above. Additional models, which included an indicator for the presence of chronic conditions at baseline, produced similar results.

TABLE 4. Linear regression prediction of normal change score* for orientation test, including all terms simultaneously among subjects aged 65 years and older, East Boston, Massachusetts, 1982–1985

Predictor	Normal score change per unit of predictor	95% confidence interval	*p* value
Alcohol consumption			
Very light (>0 to <0.5 ounce/day)†	0.099	−0.029 to 0.227	0.1
Light (0.5 to <1 ounce/day)	0.171	−0.029 to 0.371	0.09
Moderate (≥1 ounce/day)	−0.001	−0.196 to 0.194	0.9
Smoking			
Current smoker (yes/no)	0.101	−0.058 to 0.259	0.2
Former smoker (yes/no)	0.061	−0.090 to 0.213	0.4
Pack-years	0.0002	−0.002 to 0.002	0.8
Age	−0.025	−0.036 to −0.014	0.0001
Sex (male/female)	−0.036	−0.166 to 0.093	0.6
Education (years of formal schooling)	0.035	0.016 to 0.054	0.0002
Income group	0.021	−0.025 to 0.066	0.4

* Normal scores transformation of change in test result ranked within each level of baseline test result, e.g., 0 = median test result; 1 = 1 standard deviation better than median result.
† 1 ounce = 30 ml.

TABLE 5. Linear regression prediction of normal change score* for digit-span test, including all terms simultaneously among subjects aged 65 years older, East Boston, Massachusetts, 1982–1985

Predictor	Normal score change per unit of predictor	95% confidence interval	*p value*
Alcohol consumption			
Very light (>0 to <0.5 ounce/day)†	0.088	0.015 to 0.160	0.02
Light (0.5 to <1 ounce/day)	0.059	−0.054 to 0.173	0.3
Moderate (≥1 ounce/day)	0.068	−0.042 to 0.179	0.2
Smoking			
Current smoker (yes/no)	−0.013	−0.103 to 0.077	0.8
Former smoker (yes/no)	−0.062	−0.149 to 0.024	0.2
Pack-years	0.001	0.0003 to 0.002	0.01
Age	−0.004	−0.010 to 0.003	0.2
Sex (male/female)	−0.071	−0.144 to 0.003	0.06
Education (years of formal schooling)	0.033	0.023 to 0.044	0.0001
Income group	0.035	0.009 to 0.061	0.008

* Normal scores transformation of change in test result ranked within each level of baseline test result, e.g., 0 = median test result; 1 = 1 standard deviation better than median result.
† 1 ounce = 30 ml.

DISCUSSION

Predictors of cognitive decline among older persons are of great interest, especially those predictors with a potential for modification. We wanted to see whether the levels of smoking or alcohol use common among older persons were significant predictors of cognitive decline. We found no clear or consistent relation between either moderate alcohol use or smoking habits and objective measures of change in cognitive function in this defined community population.

TABLE 6. Linear regression prediction of normal change score* for immediate memory test, including all terms simultaneously among subjects aged 65 years and older, East Boston, Massachusetts, 1982–1985

Predictor	Normal score change per unit of predictor	95% confidence interval	*p* value
Alcohol consumption			
Very light (>0 to <0.5 ounce/day)†	0.033	−0.096 to 0.161	0.6
Light (0.5 to <1 ounce/day)	0.046	−0.155 to 0.247	0.7
Moderate (≥1 ounce/day)	0.181	−0.015 to 0.377	0.07
Smoking			
Current smoker (yes/no)	0.132	−0.027 to 0.292	0.1
Former smoker (yes/no)	0.049	−0.104 to 0.201	0.5
Pack-years	−0.001	−0.003 to 0.0005	0.2
Age	−0.012	−0.024 to −0.001	0.04
Sex (male/female)	−0.136	−0.267 to −0.006	0.04
Education (years of formal schooling)	0.068	0.050 to 0.087	0.0001
Income group	0.074	0.028 to 0.119	0.002

* Normal scores transformation of change in test result ranked within each level of baseline test result, e.g., 0 = median test result; 1 = 1 standard deviation better than median result.
† 1 ounce = 30 ml.

Alcohol use

Change in only one of the three tests (digit-span) was significantly associated with one category of alcohol use (less than 0.5 ounce (15 ml) per day), and no dose-response relation was observed.

To our knowledge, this is the first longitudinal study of the relation between alcohol use and changes in cognitive function in a large population of older persons. Cross-sectional studies have yielded inconsistent results, perhaps because cognitive impairment caused a modification of alcohol use, rather than vice versa. In our earlier analysis of the baseline cognitive tests, there was no significant relation between cognitive function and alcohol use (4). In a study of elderly subjects in Iowa, investigators found that those who reported drinking a small amount of alcohol (no more than one glass per week) scored significantly better on a test of memory than did those who did not drink at all (11). Those who drank more were not significantly different from nondrinkers. Among middle-aged and elderly subjects in Framingham, Massachusetts (12), performances on four of eight cognitive tests were unrelated to alcohol use; however, on the other four tests, higher consumption of alcohol was associated with better test performance. Among working-age people in Detroit (13), higher current alcohol consumption was associated with poorer performance on a test of abstraction, and no association between lifetime consumption and cognitive performance was found.

Some of the variation in results of the studies could result from differences in the levels of alcohol use in the populations, but alcohol use was not consistently higher in studies with significant results. Similarly, grouping studies by method of modeling the alcohol-cognitive function relation did not appear to explain the pattern of results. In the cross-sectional studies conducted in East Boston (4), Framingham (12), and Detroit (13), alcohol was treated as a continuous variable and was measured in ounces. Differences in cognitive function measures might account for differences in results, but no consistent pattern is evident to suggest that specific domains of cognitive function are or are not related to alcohol use.

TABLE 7. Mean normal change scores* by smoking, age, and sex, among subjects aged 65 years and older, East Boston, Massachusetts, 1982–1985

Sex and age (years)	No.	Smoking status		
		Never smoker	Former smoker	Current smoker
		Orientation test		
Men				
65–69	214	0.30	0.13	0.20
70–74	152	0.02	−0.01	−0.11
≥75	90	−0.12	−0.07	−0.33
Women				
65–69	343	0.14	0.26	0.28
70–74	232	−0.05	−0.04	0.38
≥75	170	−0.16	−0.19	−0.24
		Digit-span test		
Men				
65–69	214	0.03	0.04	0.02
70–74	152	0.03	−0.15	−0.20
≥75	90	−0.22	−0.01	0.02
Women				
65–69	343	−0.01	−0.003	0.07
70–74	232	0.002	−0.02	0.08
≥75	170	−0.13	−0.07	0.13
		Immediate memory test		
Men				
65–69	214	0.14	0.18	0.23
70–74	152	0.07	−0.03	−0.31
≥75	90	−0.08	−0.16	0.17
Women				
65–69	343	0.25	0.23	0.29
70–74	232	0.02	−0.04	0.12
≥75	170	−0.12	−0.05	0.53

* Normal scores transformation of change in test result ranked within each level of baseline test result, e.g., 0 = median test result; 1 = 1 standard deviation better than median result.

Smoking

In our longitudinal analysis, current smoking and former smoking were not significantly related to change in any of the three cognitive function tests. Cumulative exposure, measured as pack-years of smoking, was significantly related to improvement in normal change score in the digit-span test. This was counterbalanced, however, by a nonsignificant association of worsening normal change scores for both current and former smokers, so that the overall relation for a one pack-a-day smoker for 30 years was an improvement of 0.017 in the normal change score for current smokers and a worsening of −0.032 in the score for former smokers. This finding suggests that the association is not a result of smoking itself, but rather, of an unidentified confounder. Results are presented for pack-years because that is the best available measure of lifetime dose. Substituting packs per day and years of smoking produced similar results.

To our knowledge, no previous studies have investigated the longitudinal relation of smoking to decline in cognitive function in large populations. Results from earlier cross-sectional studies could be misleading because cognitive impairment may have caused cessation of smoking, thereby pro-

ducing a spurious inverse association. In the Framingham cohort, current smokers scored significantly worse on two (immediate recall and similarities) of the eight cognitive function tests (12). In the baseline data for our analyses, current smoking was not related to three of four cognitive function tests, but was associated with better immediate memory score (4).

This longitudinal study enabled us to distinguish the sequence of events by examining change in cognitive function in relation to baseline variables. Because information on smoking and alcohol use was obtained from the participants themselves before evidence of cognitive decline was present, the information is likely to be more reliable than surrogate measures. Although this study used brief, limited tests of cognitive function, the use of structured performance tests provided a clearly defined, objective measure of change. This study also provided information from a population-based cohort, and therefore, possible selection bias was minimized.

The study was limited because only information about recent alcohol use, not lifetime use, was obtained at the baseline interview. Most studies have found no significant changes in patterns of alcohol use over time (14–16). If declines in consumption did occur with aging, a relation to disease would remain if earlier consumption was correlated with consumption at the baseline interview. Limited additional data available in this study suggest that current and former consumptions are correlated. We asked participants, "Has there ever been a time when you drank quite a bit more than you drink now?" Fewer people in the two lower consumption groups than in the two higher consumption groups answered yes. If the reported alcohol consumption in the interval immediately preceding the study was not proportional to lifetime consumption, however, an association with cumulative lifetime dose could have been missed.

Another possibility is that by analyzing alcohol use in a general population of older people, we may have been unable to observe effects in small subsets of hypersensitive individuals or individuals who consumed large quantities. Although we examined both linear dose response and categorical response within the range of the data, the number of individuals drinking 2 ounces (60 ml) or more of alcohol per day was insufficient to examine the effects of heavy drinking.

It is possible that restricting analyses to those who performed well at baseline eliminated most of the individuals who declined because of smoking or alcohol use. This was unlikely, since the group who performed well contained more smokers who reported more pack-years of exposure and fewer nondrinkers. To test this possibility further, we repeated all analyses, including all levels of baseline performance. Most results for both smoking and alcohol were similar to the results reported here. The two exceptions were that the significant association of pack-years and digit span was eliminated and that the association of current and former smoking with immediate memory reached statistical significance because of increased sample size with coefficients of similar size.

Finally, these data deal with cognitive decline in general and do not provide evidence of the underlying condition that caused the decline. A subset of diseases may be related to smoking or to alcohol use. In addition, in the 3-year follow-up period, the average amount of change for the entire population was small. This may be the beginning of substantial decline for the majority of the people who declined or for only a small subset. Other studies should focus on determining whether a large cognitive decline, which reaches a clinically important level of impairment, shows a similar lack of association with smoking and alcohol use.

In summary, this study examined how lifetime smoking and low-to-moderate alcohol consumption in the recent past related to objective measures of change in cognitive function in a general population of people over age 65 years. There were few statistically significant associations among the multiple cognitive tests and multiple models for exposure. Those associations that were sig-

nificant had no consistent pattern. In a parallel study (17), we examined the same risk factors in relation to the specific diagnosis of Alzheimer's disease, the most common cause of moderate and severe cognitive impairment among older persons. Together, the results of these studies suggest that the spectrum of decline in cognitive function as well as the onset of clinical Alzheimer's disease are not statistically significantly related to smoking or alcohol use at the levels observed in this community population.

REFERENCES

1. Adams R, Victor M. Principles of neurology. New York, NY: McGraw-Hill Co., 1981:819–21.
2. Baum-Baicker C. The psychological benefits of moderate alcohol consumption: a review of the literature. Drug Alcohol Depend 1985;15:305–22.
3. Shalat SL, Seltzer B, Pidcock C, et al. Risk factors for Alzheimer's disease: a case-control study. Neurology 1987;37:1630–3.
4. Scherr PA, Albert MS, Funkenstein HH, et al. Correlates of cognitive function in an elderly community population. Am J Epidemiol 1988;128: 1084–101.
5. Albert MS, Smith LA, Scherr PA, et al. The use of brief cognitive tests to identify the individuals in the community with clinically diagnosed Alzheimer's disease. Int J Neurosci 1991;57:167–78.
6. Wechsler D. The measurement and appraisal of adult intelligence. 4th ed. Baltimore, MD: Williams & Wilkens, 1958.
7. Pfeiffer E. A short portable mental status questionnaire for the assessment of organic brain deficit in elderly patients. J Am Geriatr Soc 1975;23: 433–41.
8. Shurtleff D. Some characteristics related to the incidence of cardiovascular disease and death: Framingham study, 16-year follow-up. In: Kannel WB, Gordon T, eds. The Framingham Study. Section 26. Washington, DC: US GPO, 1970.
9. Stevens G, Featherman DL. A revised socioeconomic index of occupational status. Soc Sci Res 1981;10:364–95.
10. Kendall MG, Stuart A. The advanced theory of statistics. Vol 2. London, England: Charles Griffin and Co., 1986;504–05.
11. Wallace RB, Lemke JH, Morris MC, et al. Relationship of free-recall memory to hypertension in the elderly: the Iowa 65+ Rural Health Study. J Chronic Dis 1985;38:475–81.
12. Farmer ME, White LR, Abbott RD, et al. Blood pressure and cognitive performance: the Framingham Study. Am J Epidemiol 1987;126:1103–14.
13. Parker DA, Parker ES, Brody JA, et al. Alcohol use and cognitive loss among employed men and women. Am J Public Health 1983;73:521–6.
14. Adams WL, Garry PJ, Rhyne R, et al. Alcohol intake in the healthy elderly: changes with age in a cross-sectional and longitudinal study. J Am Geriatr Soc 1990;38:211–16.
15. Glynn RJ, Bouchard GR, LoCastro JS, et al. Aging and generational effects on drinking behaviors in men: results from the Normative Aging Study. Am J Public Health 1985;75:1413–19.
16. Temple MT, Leino EV. Long-term outcomes of drinking: a 20-year longitudinal study of men. Br J Addict 1989;84:889–99.
17. Hebert LE, Scherr PA, Beckett LA, et al. Relation of smoking and alcohol consumption to incident Alzheimer's disease. Am J Epidemiol 1992;135: 347–55.