of several smoking-related variables, yet comparison of our models 16–18 clearly underlined the difficulties in simultane- 
ously modeling age at initiation, duration, and/or time since cessation while adjusting for age (2). We demonstrated 
that including all of these variables (model 17) was not 
tenable because of multicollinearity, such that “interpreta-
tion of the resulting estimates is impossible” (2, p. 820).

McKnight et al. (3), in a study cited in our paper, focused on 
difficulties specific to simultaneous modeling of two contin-
uous exposure variables that were categorized and that both 
had an assigned value of zero for nonexposed subjects. They 
suggested a solution similar to our inclusion of a binary 
smoking status indicator in model 9 (2). However, our 
approach avoids the limitations of categorizing continuous 
variables and allows exploration of multicollinearity prob-
lems, which were ignored by McKnight et al.

It is unclear why Hoffmann and Bergmann (1) are 
concerned that in our analyses, goodness of fit improves with 
the inclusion of additional variables. Akaike’s Information 
Criterion does not necessarily improve with an increasing 
number of covariates; rather, it corrects for this number (4).

Indeed, our model 17 included one more variable than model 
16 but yielded a worse Akaike’s Information Criterion (2).

Our paper focused on fairly simple and commonly used 
approaches to modeling smoking history. We never intended to 
explore all possible approaches. Specifically, we did not 
consider interactions between continuous smoking-related 
variables, partly because none of the recent studies we screened 
assessed such interactions and partly because of space limits-
ations. For similar reasons, we did not consider more sophisti-
cated approaches mentioned in our Discussion (2).

However, it may be of interest to investigate the advan-
tages and limitations of the approach proposed by Hoffmann 
and Bergmann (1). Indeed, we believe that using their 
smoking indicator X may be especially interesting for testing 
the overall effect of smoking or adjusting for it. If the one-
component model is consistent with the true (unknown) data 
structure, it might lead to a better goodness of fit than the use 
of, for example, separate variables for cigarette-years and 
time since cessation. However, there are some potential limi-
tations of using X. First, the corresponding regression coeffi-
cient may be difficult to interpret. Moreover, the proposed 
formula of X implies, for example, a gradual leveling off of 
the effect of increasing smoking duration, which may not 
apply in some circumstances. Moreover, using X implies 
choosing a priori the values of half-time (τ) and lag (δ) 
parameters (1), both of which are likely to influence the 
results. However, in some studies there may not be sufficient 
prior knowledge to justify such choices. On the other hand, 
choosing these parameters a posteriori, as suggested by 
Hoffmann and Bergmann, may create some inferential prob-
lems, such as inflated type I error (5). Finally, some issues 
investigated in our paper (2) apply to X as well. Centering X 
and including the binary indicator of ever smoking in the 
model would help in interpreting the results of analyses that 
included never smokers. In addition, using X would not elim-
inate the problem of separating the effect of age at smoking 
initiation from other time-related smoking variables (2).

In summary, we think that the approach suggested by 
Hoffmann and Bergmann (1) may be of interest as a parsio-
monious representation of different aspects of smoking 
history. However, further investigation is needed to assess its 
potential advantages and limitations.

REFERENCES

1. Hoffmann K, Bergmann MM. Re: “Modeling smoking history: 
a comparison of different approaches.” (Letter). Am J Epidemi-
ol 2003;158:393.

smoking history: a comparison of different approaches. Am J 

3. McKnight B, Cook LS, Weiss NS. Logistic regression analysis 
for more than one characteristic of exposure. Am J Epidemiol 
1999;149:984–92.


hazard ratio: modeling and hypothesis testing with application 

Karen Leffondré1,2, Michal Abrahamowicz1,2, Jack 
Siemiatycki3,4, and Bernard Rachet4
1 Department of Epidemiology and Biostatistics, McGill 
University, Montreal, Quebec, Canada
2 Division of Clinical Epidemiology, The Montreal General 
Hospital, Montreal, Quebec, Canada
3 Département de Médecine Sociale et Préventive, 
Université de Montréal, Montreal, Quebec, Canada
4 Department of Epidemiology and Biostatistics, INRS-
Institut Armand-Frappier, Université du Québec, Laval-
des-Rapides, Quebec, Canada

RE: “COGNITIVE FUNCTION AFTER 11.5 YEARS OF ALCOHOL USE: RELATION TO ALCOHOL USE”

In the October 15, 2002, issue of the Journal, Leroi et al. 
(1) presented an interesting paper suggesting that alcohol 
consumption is associated with less cognitive decline. 
However, their analysis was limited by the fact that the 
possible confounding effect of smoking on the association 
between alcohol and cognitive function was not reported.

In a prospective analysis, we examined the association of 
cigarette smoking and alcohol consumption at baseline with 
risk of poor cognitive function 13–18 years later (2). 
Smoking was associated with increased mortality in men and 
poorer cognitive function in women. After taking into 
account the effect of smoking, we found that in women, 
increasing consumption of alcohol predicted a decline in 
performance on two cognitive function tests and that consump-
tion of two alcoholic drinks per day predicted decreased 
performance on the Buschke long-term recall task (2). 
However, the observed associations were weak, and no 
clear pattern was observed. Alcohol consumption was not 
associated with cognitive function in men.

Am J Epidemiol 2003;158:392–395
Because cigarette smoking increases the risk of death and/or institutionalization, it may have contributed to the survival bias in the Leroi et al. (1) study. Because cognitive decline has so few known modifiable risk factors, it would be very useful to see the associations after adjustment and stratification for cigarette smoking.

REFERENCES

Donna Kritz-Silverstein and Elizabeth Barrett-Connor
Division of Epidemiology, Department of Family and Preventive Medicine, University of California, San Diego, La Jolla, CA 92093

THE AUTHORS REPLY

We thank Drs. Kritz-Silverstein and Barrett-Connor for their observations (1). Edelstein et al. (2) reported that smoking is a confounding factor in the association between alcohol drinking and cognitive function. In our analysis (3), we used age, race, and education as covariates to adjust for the effect of variables other than alcohol use that might be associated with cognitive decline. We deliberately omitted drug use and cigarette smoking from the analysis because of previous reports, based on the Epidemiologic Catchment Area data set, of a lack of association between these factors and cognitive decline as measured by the Mini-Mental State Examination (4; K. Mehta, University of California, San Francisco, unpublished data). The use of the Mini-Mental State Examination may itself be a limiting factor in finding an association between smoking and cognitive decline using Epidemiologic Catchment Area data.

REFERENCES

Iracema Leroi, Jeannie-Marie Sheppard, and Constantine G. Lyketsos
Neuropsychiatry and Memory Group, Department of Psychiatry and Behavioral Sciences, Johns Hopkins University School of Medicine, Baltimore, MD 21205