RESEARCH LETTERS

Passive Smoking and Risk of Cognitive Impairment in Women Who Never Smoke

There is substantial evidence that passive smoking exposure is linked to a number of known risk factors for dementia, including cardiovascular disease.[1] Previous research has also shown that even low-level exposure to passive smoking has a negative effect on the cognitive abilities of children and adolescents.[2] But few studies have investigated the association between passive smoking exposure and cognitive impairment in older people, with conflicting findings in the direct effect on dementia.[3] In this study we determined the relationship between passive smoking exposure and the risk of cognitive impairment in women.

See also page 219

Method. The study population is derived from our 4-province study in China. The methods of the study have been fully described before.[4] Briefly, during 2008-2009 we selected 1 rural and 1 urban community from each of 4 provinces (Guangdong, Heilongjiang, Shanghai, and Shanxi) as the study fields to examine risk factors for dementia. We proposed to recruit no less than 500 participants in each community. The target population consisted of those residents 60 years or older who had lived for at least 5 years in the areas. On the basis of the residency list of the committees, we recruited a total of 4314 participants, with a response rate of 93.8%. The main interview materials were the Geriatric Mental Status (GMS)—a comprehensive semistructured mental state interview—and a general health and risk factors questionnaire,[4] including a detailed questionnaire of passive smoking exposure derived from the Scottish Monitoring of Trends and Determinants of Cardiovascular Disease (MONICA) study.[1] According to standard procedures,[1] we measured blood pressure, weight, and waist circumferences for all participants. Ethical approval for the study was obtained from the Research Ethics Committee, University College London.

Assessment of Dementia. We used a computer program–assisted diagnosis, the Automated Geriatric Examination for Computer Assisted Taxonomy (AGECAT), to analyze the information from the GMS to identify the principal mental disorders in the study participants.[4] The methods of diagnosing dementia have been fully described.[4] Briefly, AGECAT analyses of the GMS data bring symptom components together into groups that typify the major symptom areas of each diagnostic syndrome (organic disorder, depression, mania, schizophrenia and paranoia, obsessional, phobic, hypochondriacal, and general anxiety). Individual participants are allocated to levels of confidence of diagnosis (0-5) on each of the 8 diagnostic syndromes. Then the various syndrome levels are compared with one another to derive a final differential diagnosis, a level of confidence of diagnosis from 0 to 5. A level of 3 or higher, in most circumstances designates a "case level," which corresponds to a level of severity that warrants clinical intervention. Levels 1 and 2 are designated as "subcases," while level 0 (no confidence level on any syndrome) is classified as "well."[4] Dementia cases diagnosed using GMS-AGECAT algorithms have been compared with psychiatrists' diagnoses and *Diagnostic and Statistical Manual of Mental Disorders* (Third Edition) criteria and applied with good levels of agreement in a variety of settings, including elderly individuals in China.[5] The dementia subcases describe those having cognitive impairment not severe enough to qualify as a dementia case.[4]

Statistical Analysis. We analyzed data restricted to women who had never smoked (1986 of 2465 female participants). Using a Cox regression model (time variable = 1), we calculated relative risk (ie, hazard ratio) of dementia among participants experiencing passive smoking, with adjustment for age, 4-province region, urban-rurality, educational level, occupation, marital status, chronic obstructive pulmonary disease, head injuries, hypertension, and stroke. All analyses were performed in Stata, version 11 (StataCorp).

Results. Of 1986 never-smoking women, 1979 had data available for passive smoking exposure. We documented 174 dementia cases and 163 subcases. There was a significant increase in levels of dementia among 635 women exposed to passive smoking (11.7% dementia cases and 9.4% subcases) compared with those without exposure (7.4% and 7.7%). Age-adjusted relative risk (95% CI) was 1.64 (1.21-2.21) ($P = .001$) for dementia cases and 1.25 (0.91-1.72) ($P = .17$) for subcases. In the full adjustment, the matched figures were 1.39 (1.01-1.89) ($P = .04$) for dementia cases and 1.15 (0.83-1.60) ($P = .40$) for subcases.

The increased risk of dementia cases associated with passive smoking was consistent across different sources of exposure, and there was a significant cumulative dose-response relationship (**Table**). There was no such significant association for dementia subcases with passive smoking (data on request).

Comment. To our knowledge, our study is the first to investigate the association between passive smoking exposure and cognitive impairment in women, indicating that passive smoking increases the risk of cognitive impairment with a dose-response relationship. The asso-

Table. Number and Relative Risk of Dementia in Women in Relation to Sources, Duration, and Cumulative Exposure of Passive Smoking in the 4-Province Study, China

Source of Passive Smoking Exposure	Dementia Cases, No. (%)			Multivariate-Adjusted Analysis	
	Yes (n = 174)	No (n = 1805)	*P* Value	RR (95% CI)[a]	*P* Value
Exposure Levels					
At home					
None	100 (57.5)	1244 (68.9)		1 [Reference]	
No	7 (4.0)	81 (4.5)	.004	1.35 (0.62-2.94)	.45
Yes[b]	67 (38.5)	480 (26.6)		1.39 (1.00-1.92)	.047
At work					
None	100 (57.5)	1244 (68.9)		1 [Reference]	
No	29 (16.7)	387 (21.4)	<.001	1.05 (0.69-1.62)	.82
Yes[b]	45 (25.9)	174 (9.6)		1.79 (1.21-2.64)	.003
In other places					
None	100 (57.5)	1244 (68.9)		1 [Reference]	
No	27 (15.5)	301 (16.7)	<.001	1.17 (0.75-1.81)	.49
Yes[b]	47 (27.0)	260 (14.4)		1.56 (1.08-2.26)	.02
Above 3 combined (score)[c]					
None	100 (57.5)	1244 (68.9)		1 [Reference]	
Some (1-2)	48 (27.6)	463 (25.7)	<.001	1.27 (0.89-1.80)	.19
A lot (3-6)	26 (14.9)	98 (5.4)		1.73 (1.08-2.78)	.02
Exposure Duration					
At home					
None	100 (57.5)	1244 (68.9)		1 [Reference]	
No	7 (4.0)	81 (4.5)	.009	1.35 (0.62-2.94)	.45
>0-24 y	22 (12.6)	173 (9.6)		1.47 (0.91-2.37)	.12
≥25 y	45 (25.9)	307 (17.0)		1.35 (0.93-1.96)	.11
At work					
None	100 (57.5)	1244 (68.9)		1 [Reference]	
No	29 (16.7)	387 (21.4)	<.001	1.05 (0.69-1.62)	.82
>0-24 y	15 (8.6)	83 (4.6)		1.62 (0.91-2.87)	.10
≥25 y	30 (17.2)	91 (5.0)		1.90 (1.21-2.99)	.005
In other places					
None	100 (57.5)	1244 (68.9)		1 [Reference]	
No	27 (15.5)	301 (16.7)	<.001	1.17 (0.75-1.82)	.48
>0-24 y	13 (7.5)	113 (6.3)		1.30 (0.72-2.37)	.39
≥25 y	34 (19.5)	147 (8.1)		1.70 (1.12-2.58)	.01
Above 3 duration combined (year)					
None	100 (57.5)	1244 (68.9)		1 [Reference]	
>0-24 y	12 (6.9)	146 (8.1)	<.001	1.10 (0.59-2.06)	.77
25-49 y	17 (9.8)	202 (11.2)		1.27 (0.76-2.16)	.36
≥50 y	45 (25.9)	213 (11.8)		1.56 (1.07-2.29)	.02
Cumulative Exposure (Level × Duration)[d]					
None	100 (57.5)	1244 (68.9)		1 [Reference]	
>0-24 level-year	12 (6.9)	130 (7.2)		1.18 (0.63-2.22)	.60
25-49 level-year	15 (8.6)	154 (8.5)	<.001	1.33 (0.77-2.33)	.31
50-99 level-year	26 (14.9)	218 (12.1)		1.34 (0.86-2.09)	.20
≥100 level-year	21 (12.1)	59 (3.3)		1.72 (1.03-2.86)	.04

Abbreviation: RR, relative risk.

[a] Adjusted for age, 4-province geography, urban-rurality, educational level, occupation, marital status, chronic obstructive pulmonary disease, head injuries, hypertension, and stroke.

[b] The 3 scores of passive smoking exposure givin in the queationnaire were home, workplace, and other places, and the 3 choices given to the respondents were "no, none at all", "yes, some" or "yes, a lot." For the analysis, their levels of exposure were scored at 0, 1, or 2, respectively. Participants exposed to passive smoking were those with scores 1 or 2.

[c] Each participant should have a total score from 3 sources of passive smoking exosure.

[d] For the participants, their duration of passive smoking exposure was recorded in years for each source of passive smoking. Cumulative exposure was calculated as follows: exposure level ×exposure duration, eg, if 1 participant was exposed to passive smoking, with "yes, some" at home for 20 years (1×20=20), "yes, a lot" at work for 15 years (2×15=30), and "yes, some" in other places for 10 years (1×10=10), she would get a total level-duration exposure of 60. Relative risk (95% CI) per 10 level-year units in a continuous variable, 1.04 (1.00-1.07) (*P* = .04).

ciation was stronger for passive smoking exposure at work than at home or in other places.

China is the world's largest producer and consumer of tobacco. Yang et al[6] reported that in a 1996 national survey the prevalence rate for ever-smokers was 66.9% for men and 4.2% for women older than 15 years, and of the nonsmokers, 53.5% were regularly exposed to passive smoking, while the 2002 survey data suggested that

the levels of smoking and passive smoking exposure were similar to those in 1996 and not improved. Our recent data (submitted for publication) has shown that in never-smoking Chinese, older women had an approximately 50% higher risk of exposure to passive smoking than men. Thus, it is not surprising that we have found a significant relationship between passive smoking exposure and the risk of cognitive impairment in these women.

We did not measure cotinine levels to quantify passive smoking exposure, which is a main limitation of the study. Self-reported passive smoking may underestimate exposure,[7] although it can distinguish relative levels of exposure to passive smoking.[8] Our previous studies[1,9] suggested that the combination of a questionnaire and cotinine levels for measuring passive smoking exposure would increase the statistical power. Therefore the association of passive smoking with dementia in the present study may be more conservative without using cotinine levels for analysis. The findings of this study are unlikely to result from chance or bias. Large prospective studies are required to confirm the causal relationship between passive smoking and cognitive impairment. Nevertheless, more campaigns for smoking cessation and control of smoking in public areas will help reduce the risk of dementia and the encroaching worldwide dementia epidemic.

Ruoling Chen, MD, PhD
Dongmei Zhang, MD, PhD
Yang Chen, BA
Zhi Hu, MD, PhD
Ken Wilson, MD, FRCPsy

Author Affiliations: School of Health Administration, Anhui Medical University, Anhui, China (Drs R. Chen, Zhang, and Hu); Division of Health and Social Care Research, King's College London, London England (Dr R. Chen); School of Health and Wellbeing, University of Wolverhampton, Wolverhampton, England (Dr Zhang); Green Templeton College, University of Oxford, Oxford, England (Mr Chen); and Division of Psychiatry, University of Liverpool, Liverpool, England (Dr Wilson).
Correspondence: Dr R. Chen, Division of Health and Social Care Research, King's College London, Capital House, 42 Weston St, Seventh Floor, London SE1 3QD, England (ruoling.chen@kcl.ac.uk); and Dr Hu, School of Health Administration, Anhui Medical University, Anhui, China (aywghz@126.com).
Author Contributions: Dr R. Chen has full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* R. Chen. *Acquisition of data:* R. Chen and Hu. *Analysis and interpretation of data:* R. Chen, Zhang, Y. Chen, Hu, and Wilson. *Drafting of the manuscript:* R. Chen. *Critical revision of the manuscript for important intellectual content:* Zhang, Y. Chen, Hu, and Wilson. *Statistical analysis:* R. Chen and Zhang. *Obtained funding:* R. Chen. *Administrative, technical, and material support:* Zhang and Hu. *Study supervision:* R. Chen, Y. Chen, Hu, and Wilson.
Financial Disclosure: None reported.
Funding/Support: This study was funded by research grants from the Alzheimer's Research Trust and the BUPA Foundation, United Kingdom. With support from the Strategic Research Development Fund at the University of Wolverhampton, Dr Zhang visited the United Kingdom to carry out postdoctoral research under the supervision of Dr R. Chen.
Role of the Sponsors: The sponsors of the study had no role in study design, data analysis, data interpretation, or writing of the report.
Disclaimer: The opinions expressed in this report are not necessarily those of the funders.
Additional Contributions: We thank the participants and all who were involved in the survey in the 4-province study.

1. Chen R, Tavendale R, Tunstall-Pedoe H. Environmental tobacco smoke and prevalent coronary heart disease among never smokers in the Scottish MONICA surveys. *Occup Environ Med*. 2004;61(9):790-792.
2. Yolton K, Dietrich K, Auinger P, Lanphear BP, Hornung R. Exposure to environmental tobacco smoke and cognitive abilities among U.S. children and adolescents. *Environ Health Perspect*. 2005;113(1):98-103.
3. Barnes DE, Haight TJ, Mehta KM, Carlson MC, Kuller LH, Tager IB. Secondhand smoke, vascular disease, and dementia incidence: findings from the cardiovascular health cognition study. *Am J Epidemiol*. 2010;171(3):292-302.
4. Chen R, Ma Y, Wilson K, et al. A multicentre community-based study of dementia cases and subcases in older people in China-the GMS-AGECAT prevalence and socio-economic correlates [published online September 21, 2011]. *Int J Geriatr Psychiatry*. doi:10.1002/gps.2767.
5. Prince M, Acosta D, Chiu H, et al; 10/66 Dementia Research Group. Effects of education and culture on the validity of the Geriatric Mental State and its AGECAT algorithm. *Br J Psychiatry*. 2004;185:429-436.
6. Yang GH, Ma JM, Liu N, Zhou LN. Smoking and passive smoking in Chinese, 2002. *Zhonghua Liu Xing Bing Xue Za Zhi*. 2005;26(2):77-83.
7. DeLorenze GN, Kharrazi M, Kaufman FL, Eskenazi B, Bernert JT. Exposure to environmental tobacco smoke in pregnant women: the association between self-report and serum cotinine. *Environ Res*. 2002;90(1):21-32.
8. Nondahl DM, Cruickshanks KJ, Schubert CR. A questionnaire for assessing environmental tobacco smoke exposure. *Environ Res*. 2005;97(1):76-82.
9. Chen R, Tavendale R, Tunstall-Pedoe H. Measurement of passive smoking in adults: self-reported questionnaire or serum cotinine? *J Cancer Epidemiol Prev*. 2002;7(2):85-95.

Enjoying Life and Living Longer

There is accumulating evidence that positive well-being is associated with reduced mortality and risk of coronary heart disease (CHD) and other diseases of older age.[1-3] To our knowledge, this association has not previously been investigated in a nationally representative sample in which extensive health and behavioral data are available. We therefore used the English Longitudinal Study of Aging (ELSA) to evaluate prospective associations between enjoyment of life and survival.

Methods. The ELSA began in 2002 with 11 391 men and women 50 years and older living in England.[4] Comparisons of the sociodemographic characteristics of participants against results from the national census show that the sample is representative of the English population. Of the core sample, 94.8% consented to data linkage to mortality records. Participants were tracked for a mean of 7 years, 3 months. Complete data on well-being, health behavior, and survival were available from 1251 fatalities and 7774 survivors.