Stroke mortality associated with environmental tobacco smoke among never-smoking Japanese women: A prospective cohort study

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ABSTRACT

Objective. This study examined the association of exposure to environmental tobacco smoke (ETS) during adulthood with stroke and its subtypes using data from a large-scale prospective cohort study in Japan.

Methods. The study population included 36,021 never-smoking Japanese women who were enrolled between 1983 and 1985 and were followed-up for 15 years. We used Cox proportional hazard regression models to estimate hazard ratios (HRs) for stroke death associated with ETS exposure at home during adulthood.

Results. A total of 906 cases of stroke death were observed during 437,715 person-years of follow-up. Compared with never-smoking women without smoking family members, HRs for stroke mortality among never-smoking women living with smoking family members in all subjects, in those aged 40–79 years, and in those aged ≥80 years were 1.14 (95% confidence interval: 0.99–1.31), 1.24 (95% CI: 1.05–1.46), and 0.89 (95% CI: 0.66–1.19), respectively, after adjustment for possible confounders. The risk was most evident for subarachnoid hemorrhage [HR: 1.66 (95% CI: 1.02–2.70) in all subjects].

Conclusion. This study suggests that exposure to ETS at home during adulthood is associated with an increased risk of stroke among never-smoking Japanese women.

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The adverse health effects of environmental tobacco smoke (ETS) are conclusive in several smoking-related diseases, such as lung cancer and ischemic heart disease (US Department of Health and Human Services, 2006). Recent evidence suggests that ETS exposure increases the risk of stroke. The 2014 US Surgeon General's report concluded that the evidence is sufficient to infer a causal relationship between exposure to secondhand smoke and increased risk of stroke and that the estimated increase in risk for stroke is about 20%–30% (US Department of Health and Human Services, 2014). However, some issues remain to be addressed. First, few studies have investigated the association between ETS and stroke subtypes; thus the effects of ETS on stroke subtypes are not well defined. Second, the most previous studies were conducted in Western countries and Australasia; studies are relatively few in East Asia, where smoking prevalence among males is still high and control of ETS exposure is generally insufficient

(World Health Organization, 2013). In such conditions, ETS may have a greater effect on the risk of stroke than is estimated in the Surgeon General's report. Therefore, elucidating the association of ETS exposure with stroke in the East Asian region has important public health consequences. We investigated the effect of ETS exposure during adulthood on mortality from stroke and its subtypes using data from a large-scale population-based Japanese cohort study in which participants were enrolled between 1983 and 1985.

Methods

Study population and baseline survey

The Three-Prefecture Cohort Study was a prospective study to evaluate the long-term effects of air pollution and lifestyle factors on mortality. Details of the study population and baseline survey methods are described elsewhere (Katanoda et al., 2011). In brief, the study areas consisted of selected locations in Miyagi, Aichi, and Osaka prefectures, Japan, and both polluted (urban) and control (rural) areas were selected in each prefecture. The study population

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included all residents living in those areas who were aged ≥40 years. A self-administered questionnaire was delivered to 118,820 subjects according to residential registries in cooperation with municipal governments between 1983 and 1985. In total, 100,615 individuals (84.7%) responded to the questionnaire; of these, 54,192 were women.

We restricted the sample in this study to never-smoking women. Current smokers (n = 5199), former smokers (n = 1747), and individuals whose smoking status was missing (n = 9964) were thus excluded from analysis. In addition, we excluded 1033 women for whom information regarding the presence of smokers among family members living together was missing or inconsistent and 228 women with a past history of stroke. Accordingly, the final study population comprised 36,021 women.

Follow-up

Vital status and migration out of the study area were ascertained via the residential registry in each area. Causes of death were verified by vital statistics acquired with official permission. The outcome measures used were death from stroke (ICD-9 codes 430–438; ICD-10 codes I60–I69), subarachnoid hemorrhage (ICD-9 code 430; ICD-10 codes I60 and I69.0), intracerebral hemorrhage (ICD-9 code 431; ICD-10 codes I61 and I69.1), and cerebral infarction (ICD-9 codes 433–434; ICD-10 codes I63 and I69.3), classified according to the underlying cause of death. Cohort members were followed-up for 15 years from the baseline survey. The follow-up period was set according to the original protocol of this cohort study.

Statistical analysis

Person-years of follow-up for all participants were counted from the baseline survey in each study area until the date of stroke death, the date of another cause of death, the date of migration out of the study area, or the end of the 15-year follow-up period, whichever occurred first.

The baseline questionnaire in this study included questions regarding the presence of smokers among family members living together and, if smokers were present, their relationship with the participant (husband, wife, father, mother, children, and other family members). In this study, the answer was used as the index of ETS exposure at home. Specifically, subjects with at least 1 smoker among family members living together at baseline were regarded as those exposed to ETS at home. We used Cox proportional hazards regression models to estimate hazard ratios (HRs) and 95% confidence intervals (CIs) for stroke death associated with ETS exposure at home among never-smoking women.

We considered the following variables as potential confounders: age (continuous); region of residence (6 locations: urban and rural areas of Miyagi, Aichi, and Osaka); health insurance as an indicator of the socioeconomic status (national health insurance, government or union-managed health insurance, mutual-aid association health insurance, and others); history of hypertension (yes or no); history of diabetes (yes or no); body mass index (BMI) (<19.0, 19.0–21.9, 22.0–24.9, 25.0–29.9, ≥30.0 kg/m^2); alcohol consumption (never, former, current occasional, current almost every day); green and yellow vegetable consumption; non-green and non-yellow vegetable consumption; fruit consumption; miso soup consumption (≤1–2 times/month, 1–2 times/week, 3–4 times/week, almost every day); and pickled vegetable consumption (scarcely any, 1–2 times/month, 1–2 times/week, 3–4 times/week, almost every day). In addition, the smoking status of the father and mother during the participant's childhood (smoker, non-smoker, or unknown) was taken into consideration in order to independently evaluate the effect of ETS during adulthood. Missing values were treated as an additional variable category. Age-adjusted HRs and the HRs after adjustment for all categories listed above were calculated.

We also estimated HRs for stroke death stratified by age groups and according to the source of ETS exposure at home (husband and other family members). In addition, we conducted separate analyses after classifying the cause of stroke death according to stroke subtypes: subarachnoid hemorrhage, intracerebral hemorrhage, and cerebral infarction. All analyses were performed using SAS version 8.2 statistical software (SAS Institute, Cary, NC).

Results

During 437,715 person-years of follow-up involving 36,021 subjects, we documented 906 cases of stroke death, including 87 cases of subarachnoid hemorrhage, 147 cases of intracerebral hemorrhage, and 467 cases of cerebral infarction. Table 1 presents the characteristics of the study subjects at baseline according to their families' smoking status. Subjects with smoking family members constituted a high percentage of those who lived in rural areas in Miyagi and Osaka and were more likely to be obese compared with subjects without smoking family members. In addition, subjects with smoking family members had a lower frequency of consumption of vegetables and fruits and a higher frequency of consumption of salty food such as miso soup and pickled vegetables.

Table 1
Characteristics of study subjects according to familial smoking status at baseline among Three-Prefecture Cohort Study participants followed-up for 15 years.

	Smoker (−)	Smoker (+)
No. at risk	13,834	22,187
Mean age, years (SD)	56.7 (11.9)	55.9 (11.3)
Region of residence (%)		
Miyagi, urban	17.8	14.8
Miyagi, rural	7.8	14.5
Aichi, urban	29.3	19.4
Aichi, rural	10.7	11.0
Osaka, urban	18.3	19.2
Osaka, rural	16.1	21.1
Health insurance type (%)		
National health insurance	44.8	47.3
Government/union-managed health insurance	42.9	42.8
Mutual aid associations health insurance	10.5	8.6
Others	1.7	1.4
History of hypertension (%)	21.3	22.4
History of diabetes (%)	3.3	3.7
Body mass index (BMI) (%)		
<19.0 kg/m^2	13.3	10.3
19.0–21.9 kg/m^2	37.0	33.1
22.0–24.9 kg/m^2	32.7	35.4
25.0–29.9 kg/m^2	15.4	19.2
≥30.0 kg/m^2	1.5	2.1
Alcohol drinking (%)		
Never	63.7	65.0
Former	1.5	1.3
Current occasional	29.7	29.1
Current almost everyday	5.1	4.6
Green and yellow vegetable consumption (%)		
≤1–2 times/month	2.5	3.9
1–2 times/week	14.1	17.2
3–4 times/week	28.7	31.2
Almost every day	54.7	47.7
Non-green and non-yellow vegetable consumption (%)		
≤1–2 times/month	1.3	1.7
1–2 times/week	8.6	9.7
3–4 times/week	24.7	26.1
Almost every day	65.5	62.5
Fruit consumption (%)		
≤1–2 times/month	3.0	4.3
1–2 times/week	10.0	12.0
3–4 times/week	19.7	22.5
Almost every day	67.4	61.1
Miso soup consumption (%)		
≤1–2 times/month	7.9	6.5
1–2 times/week	18.6	16.1
3–4 times/week	20.9	20.1
Almost every day	52.6	57.2
Pickled vegetable consumption (%)		
Scarcely any	5.4	3.5
1–2 times/month	6.1	4.1
1–2 times/week	13.2	10.3
3–4 times/week	16.3	13.5
Almost every day	59.1	68.8
Smoking status of father during childhood (%)		
Smoking	66.2	68.7
Non-smoking	27.8	24.1
Unknown	6.0	7.3
Smoking status of mother during childhood (%)		
Smoking	9.1	10.2
Non-smoking	87.8	85.6
Unknown	3.1	4.2