International Journal of Gerontology 6 (2012) 127–130

Contents lists available at SciVerse ScienceDirect

International Journal of Gerontology

journal homepage: www.ijge-online.com

Original Article

Smoking After Age 65 Years and Mortality: The Kangwha Cohort Study☆

Byung Heon Cha [1], Bayasgalan Gombojav [2], Jae Woong Sull [1]*, Heechoul Ohrr [2]

[1] Department of Biomedical Laboratory Science, College of Health Science, Eulji University, Sungnam-Si, Gyeongi-Do, [2] Department of Preventative Medicine, Yonsei University College of Medicine, Seoul, Korea

ARTICLE INFO

Article history:
Received 22 April 2011
Received in revised form
17 January 2012
Accepted 20 February 2012
Available online 6 June 2012

Keywords:
cardiovascular disease,
cognitive impairment,
mortality,
smoking

SUMMARY

Background: The relationship between smoking and mortality in elderly people, especially in women, is unclear. The present paper examines the association between smoking and the risk of mortality due to all causes of death with a special focus on cardiovascular disease in elderly Korean men and women.
Methods: This study followed a cohort of 2201 residents (934 males and 1267 females) in Kangwha county who were ≥ 65 years of age. All patients were followed from March 1994 through December 31, 2005 (11.8 years) in order to determine cause-specific mortality. We calculated the hazard ratio of mortality according to smoking status using the Cox proportional hazard model.
Results: During the 11.8 years of the study duration, 529 men and 498 women died. Current female smokers also demonstrated higher levels of cognitive impairment than nonsmokers. Current female smokers demonstrated significantly increased risks of mortality from deaths due to all causes and total cardiovascular disease in comparison with female nonsmokers. The hazard ratio (95% confidence interval) of mortality was 1.32 (1.05–1.66) for all causes and 1.76 (1.10–2.82) for total cardiovascular disease. Current male smokers also demonstrated an increased risk of mortality due to all causes in comparison with male nonsmokers, but this outcome was not statistically significant.
Conclusion: The results of this study suggest that smoking has a harmful effect on the risk of mortality due to cardiovascular diseases in elderly Korean women. However, these findings need to be confirmed by further studies.

1. Introduction

Tobacco smoking has been well established as a causal risk factor for multiple diseases[1]. In 2000, the prevalence of smoking in Korea was 68% among men and 3% among women[2], but the male smoking rate had decreased to 40.9% by 2008[3]. A comparison of the rates of male smokers who are ≥ 15 years old in Organization for Economic Cooperation and Development (OECD) countries in 2005 revealed that the South Korea's smoking rate was 17.8% higher than the OECD average[4].

Many prospective studies have shown that a significant portion of the all-cause mortality, including lung cancer and cardiovascular disease (CVD), is caused by cigarette smoking[5,6]. Some studies have reported that cigarette smoking is associated with all-cause mortality in elderly people[7–9]. Other Western studies have reported a lower risk of mortality from smoking in older persons than those who are middle-aged[10]. However, prospective studies on smoking and mortality in elderly people, especially women, are sparse. The purpose of this study was to examine the effect of smoking on all-cause mortality risk over an 11.8-year period, after controlling for the effects of confounding factors, using a large sample of elderly Korean patients who were residing in a community for persons ≥ 65 years of age.

2. Methods

2.1. Study population

The primary survey of the Kangwha cohort was conducted in March 1985[11,12]. Kangwha county consists of several islands located

☆ Disclosure of conflicts of interest: I certify that all my affiliations with or financial involvement in, within the past 5 years and foreseeable future, any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript are completely disclosed (e.g., employment, consultancies, honoraria, stock ownership or options, expert testimony, grants, patents received or pending, royalties).

* Correspondence to: Dr Jae Woong Sull, Department of Biomedical Laboratory Science, College of Health Science, Eulji University, Sungnam-Si, Gyeongi-Do 461-713, Korea.
E-mail address: jsull@eulji.ac.kr (J.W. Sull).

1873-9598/$ – see front matter
doi:10.1016/j.ijge.2012.05.015

approximately 50 km west of Seoul, Korea. Its population was 71,116 in 1993[12]. The number of Kangwha county residents that were ≥ 55 years of age in February 1985 was 9378. Among these, 67.9% (6373 residents) participated in the primary survey. In March 1994, a secondary survey, including interviews for the Mini-Mental State Examination (MMSE), was carried out. The present study used the data obtained from the secondary survey of the Kangwha cohort. In the 9-year follow-up period from March 1985 to March 1994, 2797 of the 6373 participants died. Therefore, 3576 participants were available for the secondary survey that was conducted in March 1994. Of these 3576 individuals, those who were not followed after the initial survey ($n = 83$) and those who had no information available on smoking ($n = 223$) or alcohol consumption, body mass index (BMI), MMSE, or chronic disease ($n = 1069$) were excluded. Thus, the final study population included 2201 individuals (934 males and 1267 females). They were followed to determine the causes of mortality for a maximum of 11.8 years until December 31, 2005. The institutional review board of human research at Yonsei University approved this study (approval no. 4-2007-0182).

2.2. Baseline data collection

The investigative team interviewed each patient using a structured questionnaire to determine the following demographic characteristics: age, sex, education, health behaviors (smoking and drinking), and other factors. Cognitive function was measured using MMSE[13]. The MMSE test was classified according to the following items: orientation to time, orientation to place, repetition and registration, attention and calculation, recall, naming, repetition, comprehension, reading, writing, and drawing. The MMSE scores ranged from 0–30. Cut-off points defined in previous studies were used to categorize the MMSE scores[14,15]. Cognitive impairment was defined as an MMSE score < 15. To assess any chronic conditions, the study participants were asked to answer yes or no to the following question: "Do you have any chronic diseases, or a previous accident or injury, that makes it uncomfortable for you during your daily life, including work?" BMI was calculated as the ratio of body weight (kg) to height (in meters squared).

2.3. Outcome assessment

The main outcomes of this research are cause-specific deaths. Data on deaths and their causes from March 1, 1994 through December 31, 2005 were obtained from the Statistics on the Causes of Death of Korea that are maintained by the Korea National Statistical Office, Daejeon, Korea. The International Classification of Diseases 10th Revision (ICD-10) from the Ministry of Health and Welfare in Korea was applied to define the causes of death.

2.4. Statistical analysis

We used the Cox proportional hazard model to examine the relationship between smoking status at baseline and the subsequent risk of total mortality. The analyses were stratified according to sex. To adjust for confounding variables, we used two models: model I was only adjusted for age (as a continuous variable), and model II was adjusted according to the history of chronic disease, alcohol consumption (nondrinkers/drinkers), BMI (as a continuous variable), cognitive impairments (normal/impaired), and educational status (no education/elementary education/highly educated). The results are expressed using hazard ratios (HRs) and 95% confidence intervals (CIs). A significance level of $p < 0.05$ was used to indicate the statistical significance for each test. Analyses were performed using SAS for Windows (version 9.1) (SAS Institute Inc., Cary, NC, USA).

3. Results

The sociodemographic characteristics of the smokers and nonsmokers are shown in Table 1 and Table 2, respectively. Nonsmokers were more obese than smokers in both Korean men and women. Smokers were older than nonsmokers in women. Alcohol consumption was associated with smoking in both men and women. Current female smokers also had a higher rate of cognitive impairment than nonsmokers.

During the 11.8 years of follow-up, 529 men and 498 women died. Table 3 shows the HRs of mortality from all causes and cause-specific diseases among Korean women. Compared with female nonsmokers, current female smokers demonstrated significantly increased risks of mortality from deaths due to all causes and total CVD. The HR (95% CI) of mortality was 1.32 (1.05–1.66) for all causes and 1.76 (1.10–2.82) for CVD.

Table 4 provides the HRs of mortality from all causes and cause-specific diseases among Korean men. Male smokers were compared with nonsmokers. The HR for mortality due to smoking was not statistically significant in all categories. The HR (95% CI) of mortality was 1.09 (0.87–1.36) for all causes and 1.19 (0.71–2.01) for total CVD, respectively. In males, we further divided current smokers into two groups: those who smoked 1–19 cigarettes/day and those who smoked ≥ 20 cigarettes/day. Compared with nonsmokers, current smokers who consumed ≥ 20 cigarettes/day were at increased risk of all-cause mortality. The association was marginally significant, demonstrating an HR (95% CI) of 1.34 (0.99–1.81) (data now shown).

4. Discussion

In this study, we analyzed smoking and mortality in the Kangwha cohort that was established in 1994 as a way to evaluate the health of people ≥ 65 years of age. We found that smoking is associated with the risks of mortality due to death from all causes and CVD in elderly Korean women, even after controlling for the confounding effects of other potential risk factors such as age, BMI, education, alcohol consumption, cognitive impairment, and history of chronic disease. A study conducted in Hong Kong showed that

Table 1
Baseline characteristics of Korean women in the Kangwha cohort study, according to smoking status.

Characteristics	Female participants ($n = 1267$)			F or $\chi 2$ value
	Nonsmokers ($n = 1037$)	Ex-smokers ($n = 31$)	Current smokers ($n = = 199$)	
	Mean ± SD	Mean ± SD	Mean ± SD	
Age (y)	73.2 ± 6.1	75.3 ± 7.2	75.3 ± 6.1	11.2**
BMI	22.6 ± 3.6	22.1 ± 4.2	21.4 ± 3.7	10.6**
	n (%)	*n* (%)	*n* (%)	
Chronic disease[a]				1.48
Never	626 (60.4)	16 (51.6)	125 (62.8)	
Yes	411 (39.6)	15 (48.4)	74 (37.2)	
Education				4.49
None	799 (77.0)	27 (87.1)	158 (79.4)	
Elementary	228 (22.0)	3 (9.7)	39 (19.6)	
High	10 (1.0)	1 (3.2)	2 (1.0)	
Alcohol consumption				66.2**
Nondrinkers	972 (93.7)	25 (80.7)	151 (75.9)	
Drinkers	65 (6.3)	6 (19.3)	48 (24.1)	
Cognitive impairment				13.4**
Normal (≥ 15)	768 (74.1)	14 (45.2)	140 (70.4)	
Impaired (<15)	269 (25.9)	17 (54.8)	59 (29.7)	

** $p < 0.01$.
[a] Study participants were asked to answer yes or no to the following question: "Do you have any chronic diseases, or a previous accident or injury, that makes it uncomfortable for you during your daily life, including work?".

Table 2
Baseline characteristics of Korean men in the Kangwha cohort study, according to smoking status.

Characteristics	Male participants ($n = 934$)			F or $\chi 2$ value
	Nonsmokers ($n = 226$)	Ex-smokers ($n = 171$)	Current smokers ($n = 537$)	
	Mean ± SD	Mean ± SD	Mean ± SD	
Age (y)	73.7 ± 5.6	73.1 ± 5.4	73.3 ± 5.4	0.71
BMI	22.1 ± 3.1	21.8 ± 3.3	20.7 ± 2.7	24.1**
	n (%)	*n* (%)	*n* (%)	
Chronic disease[a]				2.98
Never	143 (63.3)	98 (57.3)	347 (64.6)	
Yes	83 (36.7)	73 (42.7)	190 (35.4)	
Education				2.39
None	68 (30.1)	58 (33.9)	181 (33.7)	
Elementary	137 (60.6)	97 (56.7)	318 (59.2)	
High	21 (9.3)	16 (9.4)	38 (7.1)	
Alcohol consumption				43.7**
Nondrinkers	134 (59.3)	80 (46.8)	182 (33.9)	
Drinkers	92 (40.7)	91 (53.2)	355 (66.1)	
Cognitive impairment				0.63
Normal (≥ 15)	210 (92.9)	161 (94.2)	496 (92.4)	
Impairment (< 15)	16 (7.1)	10 (5.9)	41 (7.6)	

** $p < 0.01$.
[a] Study participants were asked to answer yes or no to the following question: "Do you have any chronic diseases, or a previous accident or injury, that makes it uncomfortable for you during your daily life, including work?".

current and former smokers are at increased risk of all-cause death, including both elderly male and female Chinese smokers[8]. Another recent study reported that habitual smoking contributes to higher mortality, even in an elderly Japanese population[16]. Several other studies that were conducted in Western countries also reported that smoking, even in elderly patients, is associated with all-cause mortality[9,10].

In the present study, current smoking was associated with deaths due to cardiovascular disease in the female participants. It has been reported that habitual smoking is the single biggest risk factor associated with the development of CVD in females[7,16,17]. A Japanese study also reported that smoking in 80-year-old Japanese patients is more strongly associated with the risk of developing CVD in females than males[16]. Pope et al also suggested that the toxic effects of smoking on the coronary artery may be more evident in females than in males[18].

The relationship between smoking and cognitive impairment is still unclear. Some studies have suggested that smoking might be a risk factor for the development of dementia[19,20]. Several other studies have suggested that smoking improves cognitive performance[21]. In the present study, smoking was associated with cognitive impairment in women.

The probable mechanisms for the association between smoking and mortality are well known. Cigarette smoke contains a large amount of free radicals, resulting in endothelial injury. Oxidative stress can damage many cellular components, including DNA, lipid membranes, and proteins, and may lead to apoptosis and cell damage[22]. On the other hand, nicotine, which is a major component of cigarette smoke, promotes inflammation and has a direct effect on human adipose tissue[23].

Our study has many notable strengths. The prospective study design minimized recall bias. The follow-up period (11.8 years) was relatively long compared with other studies on elderly patients. Several potential limitations, however, should be noted. First, data on smoking variables were collected through a questionnaire filled out by the participants in the Kangwha cohort ≥ 65 years of age. Some could question the validity of this approach. However, when a Korean study collected data on the smoking habits of elderly participants using a questionnaire in 1998, its reliability and validity were evaluated as being high[24]. Second, some of the sample sizes were small with a limited number of cases. Analyses of former female smokers and male nonsmokers may have limited statistical power due to the insufficient number of cases. Third, selection bias is often an issue in studies on the smoking habits of elderly people. However, when participants who died during the first 2 years of the follow-up period were excluded from the analysis, the results of the analysis were not different.

In conclusion, when the mortality risk of smokers was compared with that of nonsmokers, the mortality risk from total cardiovascular disease was high in current female smokers. However, because the study population consisted of people ≥ 65 years of age who were living in an agricultural community with a small population of female smokers, further studies are needed to truly understand the risks of smoking in the entire population.

Table 3
Number of deaths and adjusted hazard ratios of Korean women according to smoking status.

Cause of death	Female participants ($n = 1267$)		
	Nonsmokers ($n = 1037$)	Ex-smokers ($n = 31$)	Current smokers ($n = 199$)
All cause			
No. of deaths	381	15	102
HR (95% CI)[a]	1.00	1.24 (0.74–2.01)	1.25 (1.00–1.56)
HR (95% CI)[b]	1.00	1.24 (0.74–2.09)	1.32 (1.05–1.66)
Cardiovascular disease			
No. of deaths	81	0	25
HR (95% CI)[a]	1.00	—	1.58 (1.01–2.49)
HR (95% CI)[b]	1.00	—	1.76 (1.10–2.82)
Cancer			
No. of deaths	38	2	12
HR (95% CI)[a]	1.00	2.10 (0.51–8.72)	1.98 (1.03–3.83)
HR (95% CI)[b]	1.00	2.23 (0.53–9.37)	1.77 (0.89–3.55)

HR, hazard ratio; CI, confidence interval.
[a] Adjusted for age (year of recruitment) using the Cox proportional hazard model.
[b] Adjusted for age (year of recruitment), history of chronic disease, alcohol consumption, body mass index, cognitive impairment, and education status using the Cox proportional hazard model.

Table 4
Number of deaths and adjusted hazard ratios of Korean men according to smoking status.

Cause of death	Male participants ($n = 934$)		
	Nonsmokers ($n = 226$)	Ex-smokers ($n = 171$)	Current smokers ($n = 537$)
All cause			
No. of deaths	119	100	310
HR (95% CI)[a]	1.00	1.20 (0.92–1.57)	1.21 (0.98–1.49)
HR (95% CI)[b]	1.00	1.13 (0.87–1.48)	1.09 (0.87–1.36)
Cardiovascular disease			
No. of deaths	23	15	52
HR (95% CI)[a]	1.00	0.94 (0.49–1.80)	1.06 (0.65–1.73)
HR (95% CI)[b]	1.00	0.97 (0.50–1.86)	1.19 (0.71–2.01)
Cancer			
No. of deaths	25	17	71
HR (95% CI)[a]	1.00	1.01 (0.52–1.77)	1.25 (0.79–1.97)
HR (95% CI)[b]	1.00	0.91 (0.49–1.70)	1.14 (0.71–1.85)

HR, hazard ratio; CI, confidence interval.
[a] Adjusted for age (year of recruitment) using the Cox proportional hazard model.
[b] Adjusted for age (year of recruitment), history of chronic disease, alcohol consumption, body mass index, cognitive impairment, and education status using the Cox proportional hazard model.

Source of funding

This work was supported by a grant from the Korea Science and Engineering Foundation (KOSEF: R-01-1993-000-00073-0) that was funded by the Korean government (the Ministry of Education, Science and Technology).

References

1. U.S. Department of Health and Human Services. *The Health Consequences of Smoking: a Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2004.
2. Korea Gallup. Survey on the smoking prevalence. *The Korea Gallup Report*; 2001.
3. Chung W, Lim S, Lee S, et al. The effect of cigarette price on smoking behavior in Korea. *J Prev Med Public Health*. 2007;40:371−380.
4. OECD Health Data. *Statistics and indicators for 30 Countries*. Paris: OECD; 2008.
5. Doll R, Peto R, Boreham J, et al. Mortality in relation to smoking: 50 years' observations on male British doctors. *BMJ*. 2004;328:1519−1527.
6. Jee SH, Samet JM, Ohrr H, et al. Smoking and cancer risk in Korean men and women. *Cancer Causes Control*. 2004;15:341−348.
7. Lam TH, Li ZB, Ho SY, et al. Smoking, quitting and mortality in an elderly cohort of 56,000 Hong Kong Chinese. *Tob Control*. 2007;16:182−189.
8. Sunyer J, Lamarca R, Alonso J. Smoking after age 65 years and mortality in Barcelona, Spain. *Am J Epidemiol*. 1998;148:575−580.
9. Tessier JF, Nejjari C, Letenneur L, et al. Smoking and eight-year mortality in an elderly cohort. *Int J Tuberc Lung Dis*. 2000;4:698−704.
10. Vogt MT, Cauley JA, Scott JC, et al. Smoking and mortality among older women: the study of osteoporotic fractures. *Arch Intern Med*. 1996;156:630−636.
11. Sull JW, Yi SW, Nam CM, et al. Binge drinking and mortality from all causes and cerebrovascular diseases in Korean men and women: a Kangwha cohort study. *Stroke*. 2009;40:2953−2958.
12. Sull JW, Yi SW, Nam CM, et al. Binge drinking and hypertension on cardiovascular disease mortality in Korean men and women: A Kangwha cohort study. *Stroke*. 2010;41:2157−2162.
13. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state": a practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res*. 1975;12:189−198.
14. Bassuk SS, Wypij D, Berkman LF. Cognitive impairment and mortality in the community-dwelling elderly. *Am J Epidemiol*. 2000;151:676−688.
15. Andersen K, Nybo H, Gaist D, et al. Cognitive impairment and mortality among nonagenarians: The Danish 1905 cohort survey. *Dement Geriatr Cogn Disord*. 2002;13:156−163.
16. Fujisawa K, Takata Y, Matsumoto T, et al. Impact of smoking on mortality in 80-year-old Japanese from the general population. *Gerontology*. 2008;544: 210−216.
17. Iso H, Date C, Yamamoto A, et al. JACC Study Group. Smoking cessation and mortality from cardiovascular disease among Japanese men and women: the JACC Study. *Am J Epidemiol*. 2005;161:170−179.
18. Pope M, Ashley MJ, Ferrence R. The carcinogenic and toxic effects of tobacco smoke: are women particularly susceptible? *J Gend Specif Med*. 1999;2:45−51.
19. Anstey KJ, von Sanden C, Salim A, et al. Smoking as a risk factor for dementia and cognitive decline: a meta-analysis of prospective studies. *Am J Epidemiol*. 2007;166:367−378.
20. Sharifi F, Hedayat M, Fakhrzadeh H, et al. Hypertension and cognitive impairment: Kahrizak elderly study. *Int J Gerontol*. 2011;5:212−216.
21. Wang CC, Lu TH, Liao WC, et al. Cigarette smoking and cognitive impairment: a 10-year cohort study in Taiwan. *Arch Gerontol Geriatr*. 2010;51:143−148.
22. Papa S, Skulachev VP. Reactive oxygen species, mitochondria, apoptosis and aging. *Mol Cell Biochem*. 1997;174:305−319.
23. Andersson K, Arner P. Systemic nicotine stimulates human adipose tissue lipolysis through local cholinergic and catecholaminergic receptors. *Int J Obes Relat Metab Disord*. 2001;25:1225−1232.
24. Park BJ, Kim DS, Koo HW, et al. Reliability and validity study of a life style questionnaire for elderly people. *Korean J Prev Med*. 1998;31:49−58.