Cigarette smoking and the risk of unintentional injury death: a nationwide cohort study in Korea

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ABSTRACT

Cigarette smoking and the risk of unintentional injury death

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Introduction

External causes of death account for nearly 8% of all worldwide deaths annually. There were previous studies about the association between cigarette smoking and external causes of death. But most of them were focused on intentional self-harm death (suicide). The association between cigarette smoking and unintentional injury death has not been fully investigated. Thus, we examined the long-term and short-term effect of smoking status on mortality from unintentional injury and other external causes using the Korea National Health Insurance database.

Methods

We identified 493,031 persons aged 40 to 79 years, who were participants of National Health Insurance Service-Health Screening Cohort (NHIS-HEALS) in 2002 and 2003. Risk of external causes of death was estimated using a Cox proportional hazards model with and without time-dependent smoking status to estimate hazard ratios (HR) and 95% confidence intervals (95% CI) in men and women, separately. Smoking status was categorized as 'never smoker', 'past smoker', or 'current smoker'. Smoking status at event time was used for three categories ('never smoking', 'past smoking', or 'current smoking') in time dependent (extended) Cox regression. Unintentional injury death and other external causes of death were assessed using Korean Standard Classification of Diseases (KCD). External causes of death include unintentional injury death, intentional self-harm, and homicide. Unintentional injury death is further categorized into those of seven subcategories: transport accident, fall, drowning, suffocation, fire, poisoning, and other unintentional injury. Cox models were adjusted for demographics, biological, and lifestyle factors, including age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index score, income level and disability degree.

Results

In both sex, current smoker has higher risk of external causes of death (men HR=1.25, 95%CI=1.16-1.34; women HR=1.85, 95%CI=1.49-2.30), unintentional injury death (men HR=1.14, 95%CI=1.04-1.25; women HR=1.95, 95%CI=1.50-2.54) and intentional self-harm death (men HR=1.44, 95%CI=1.28-1.61; women HR=1.60, 95%CI=1.08-2.38) than never smoker, but not in homicide (men HR=0.88, 95%CI=0.39-2.00; women HR=2.89, 95%CI=0.91-9.17). When using time-dependent Cox regression, the result was similar. In both sex, current smoking at event time

has higher risk of external causes of death (men HR=1.44, 95%CI=1.34-1.54; women HR=1.64, 95%CI=1.28-2.11), unintentional injury death (men HR=1.27, 95%CI=1.16-1.39; women HR=1.61, 95%CI=1.17-2.21) and intentional self-harm death (men HR=1.76, 95%CI=1.57-1.97; women HR=1.67, 95%CI=1.06-2.57) than never smoking at event time, but not in homicide (men HR=0.95, 95%CI=0.46-1.99; women HR=not available due to small number of events). In subgroup of unintentional injury death, current smoker has higher risk of suffocation death (HR=2.41, 95%CI=1.38-4.21) in men, and higher risk of fall death (HR=2.59, 95%CI=1.29-5.21) and other unintentional injury death (HR=2.54, 95%CI=1.73-3.74) in women than never smoker. In time-dependent Cox regression, current smoking at event time has higher risk of transport accident death (HR=1.17, 95%CI=1.03-1.33), suffocation death (HR=1.97, 95%CI=1.15-3.40), and other unintentional injury death (HR=1.36, 95%CI=1.14-1.62) in men, and higher risk of other unintentional injury death (HR=1.91, 95%CI=1.17-3.11) in women than never smoking at event time. Among these statistically significant subgroups of unintentional death, there were dose-response relationships between baseline smoking intensity and subgroups of unintentional injury death, except transport accident. Past smoking at event time has higher risk of suffocation death (HR=2.14, 9%CI=1.06-4.35) in men and, and other unintentional injury death (HR=2.87, 95%CI=1.68-4.90) in women than never smoking.

Conclusion

In summary, smoking is associated with not only increased risk of intentional self-harm death, but also increased risk of unintentional injury death both in long-term and short-term in Korean men and women. In long-term effect, current smoker has higher risk of suffocation death in men and fall, other unintentional injury death in women. In short-term effect, current smoking at event time has higher risk of transport accidents, suffocation, and other unintentional injury death in men, and

higher risk of other unintentional injury death in women than never smoking at event time (short-term effect). Because the risk of unintentional injury death could be reduced after smoking cessation, it is necessary to implement a policy to reduce smoking rates or prevent smoking while doing dangerous works or driving, to reduce unintentional injury death.

[Key words] cigarette smoking, smoking cessation, accidental injuries, accident prevention, proportional hazards models

I. INTRODUCTION

1. *Background*

According to the World Health Organization, Injuries – both unintentional and violence-related (intentional) – take the lives of 4.4 million people around the world each year and constitute nearly 8% of all deaths.[1] Of the 4.4 million injury-related deaths, unintentional injuries take the lives of 3.16 million people every year and violence-related injuries kill 1.25 million people every year.[1] Roughly 1 in 3 of these deaths result from transport accident, 1 in 6 from intentional self-harm, 1 in 10 from homicide and 1 in 61 from war and conflict.[1] Injuries and violence are responsible for an estimated 10% of all years lived with disability.[1]

In Korea, external causes of death account for more than 9% of all deaths annually. Although the mortality rate of external causes of death has decreased compared to 2009 (65.8 deaths per 100,000 people), 53.1 deaths per 100,000 people still died from accidents in 2019.[2] The mortality rate is high in the order of intentional self-harm (26.9%), transport accident (8.2%), and fall (5.2%), and others like drowning, fire, poisoning.[2] Except intentional death like intentional self-harm or homicide, 25.4 deaths per 100,000 people died from unintentional injuries.[2]

Meanwhile, in worldwide, about three quarters of deaths from transport accident, four fifths of deaths from homicide, and two thirds of deaths from war are among men.[1] Across all ages, the three leading causes of death from injuries for males are transport accident, homicide, and intentional self-harm, while for females they are transport accident, fall and intentional self-harm.[1] In Korea, the mortality rate of external causes of death in male is 2.3times more than in female, as it was also in worldwide.[2] The sex ratio of mortality is in the order of drowning accidents (4.0 times), transport

accidents (3.0 times), and fall (2.6 times).[2] The tendency of external causes of death between men and women might be different.

Although the prevalence of cigarette smoking has declined in Western countries over the past few decades, a comparable decline among males has not been observed in Asian countries, especially in South Korea, where approximately 40%–50% of men and 4%–8% of women have been identified as smokers.[3] There are many contributing factors for such high prevalence, including the historically low cost of cigarettes (approximately US $2.20 per pack), the relatively scarce anti-smoking campaigns and legislations, and social factors that encourage smoking.[3] In addition, the recent emergence of electronic nicotine delivery systems (ENDS, e-cigarettes), which have been extensively marketed, is an additional challenge.[3]

Smoking is known to be not only associated with chronic diseases such as several types of cancer[4-9] and cardiovascular disease,[10-13] but also associated with injuries.[14-18] Some epidemiological studies have reported that smoking is associated with injury and injury death.[15-18] There has been a previous study about the association between smoking and unintentional injuries in Korea.[19] They concluded that cigarette smoking is associated with unintentional injuries in a dose-response manner in Korean adults.[19] This study was a first attempt to study the association between smoking and unintentional injuries in a national representative sample of Korean adults. But it was a cross-sectional study and outcome was not external causes of death but accident itself.

There was another study about the association between smoking and injury death in Taiwan.[20] This study demonstrated the significant association between fatal injuries including transport accident and non-transport accident and smoking.[20] But this study was conducted only in men and total subject was 64,319 and did not reflect time dependent characteristics of smoking status. Smoking is

a covariate that can change over time. Therefore, it could be a limitation to analyze only with the baseline smoking status of the study.

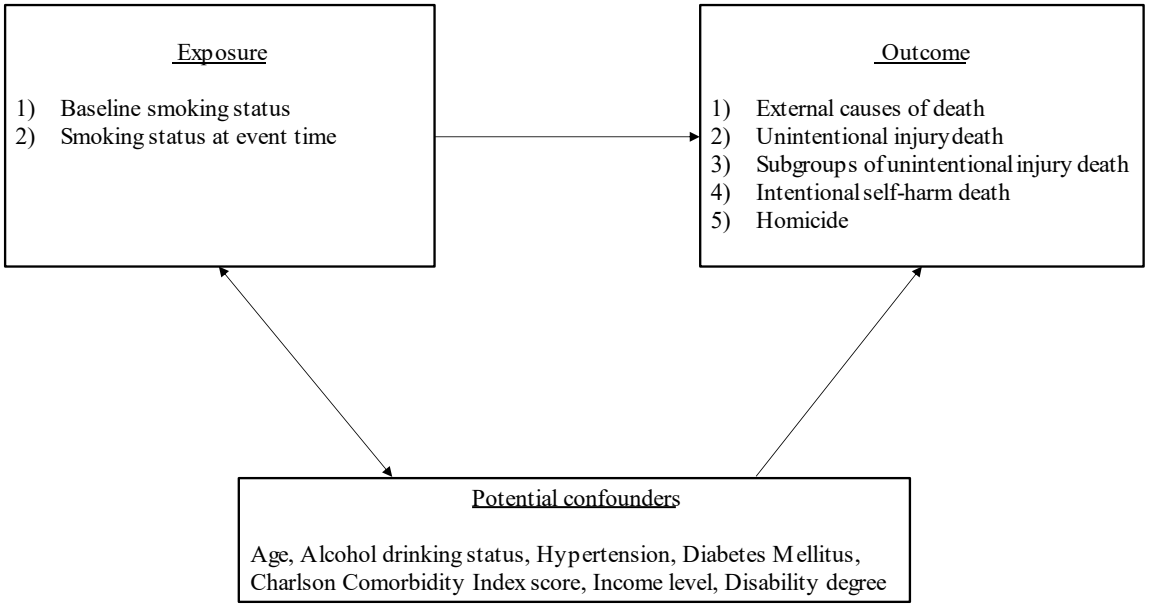
In common, previous studies investigating the impact of smoking status on external causes of death had several limitations. Limited smoking status measurements were used in cross-sectional studies. Additionally, even in a longitudinal study setting, because of rare events of external causes of death, previous studies couldn't categorize subgroup of external causes of death. Furthermore, even though there were other previous studies about the association between cigarette smoking and external causes of death, most of them were focused on intentional self-harm death.[21-27] The association between cigarette smoking and unintentional injury death has not been fully investigated in Korea.

Since unintentional injury death are very rare, large scale and long term follow up studies are necessary for more accurate association between smoking and unintentional injury death, especially in women. Also, smoking status could change over time, hence, studies about the association between smoking and unintentional injury death considering time-dependent smoking status would be needed. Given inconsistent results, more studies with smoking status reflecting its time-dependent characteristics are required to yield more definitive answers. Thus, we examined the long-term and short-term effect of smoking status on mortality from unintentional injury and other external causes using the Korea National Health Insurance database.

2. *Objective of the study*

Association between smoking considering time-dependent status and external causes of death, especially unintentional injury death including subgroups has never been reported. Thus, we examined the long-term and short-term effect of smoking status on unintentional injury death including subgroups in Korea over 14 years (2002-2015) using a nationwide population-based cohort study (Figure 1).

Figure 1. Framework of analysis of association between smoking and external causes of death considering potential confounders

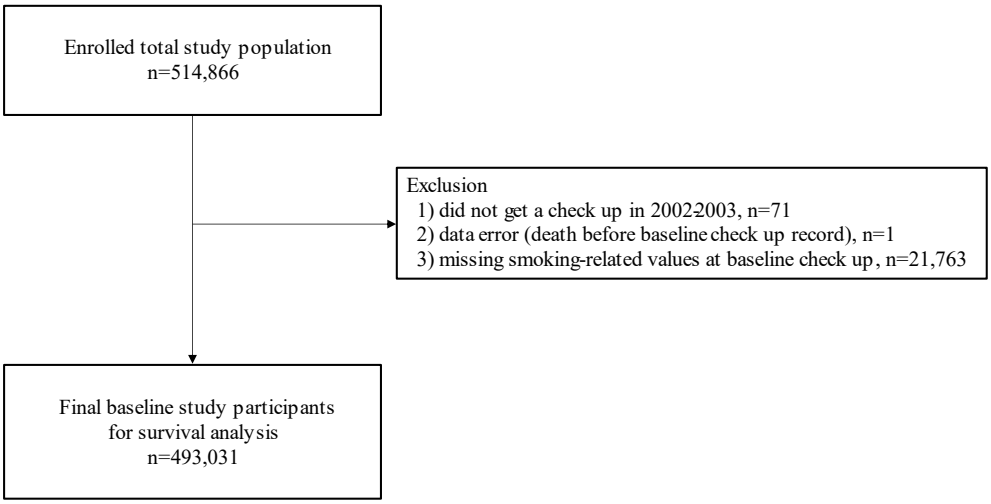


II. MATERIALS AND METHODS

1. *Data and study participants*

In the current study, data from National Health Insurance Service-Health Screening Cohort (NHIS-HEALS) were used. Detailed information of the data has been previously reported.[28] This cohort was first selected from the 2002 and 2003 health screening participants, who were aged between 40 and 79 in 2002 and followed up through 2015.[28] This cohort included 514,866 health screening participants who comprised a random selection of 10% of all health screening participants in 2002 and 2003.[28] The cohort was followed up through 2015 annually for the eligibility information including death information and healthcare usage (all participants), and not annually for the health screening information (only those who meet the eligibility criteria, biennially, for the screening program and those who participated in the screening program). In the present study, we used the participants' baseline examination data and data from follow up surveys which were conducted biennially, basically. However, not all participants received health screening every two years, so the follow-up period could be different. Total number of screenings in each participant were different and 59% of all participants received more than 6 screenings during 14 years of follow up. 3% of all participants received 14 screenings, without missing a single year (Appendix Table 8). We excluded participants who did not get a health screening programs in 2002-2003 (n=71), those who died before baseline health screening programs caused by record error (n=1), or those who had missing data on smoking-related values at baseline health screening programs (n=21,763). Hence, 493,031 participants (266,239 men and 226,792 women) were included in the final analyses. Details on the exclusion criteria are provided in Figure 2.

Figure 2. Flow chart of study participants in a survival analysis



2. *Measurements*

Assessment of exposure variable: smoking status

Participants were asked to answer questions about their smoking status. Smoking status was initially queried as 'never smoker', 'past smoker', or 'current smoker'. This question was repeatedly measured for every biennial health screening programs. In sensitivity analysis, smoking status was divided into two groups ('current smoker': current smoker, 'non smoker': never smoker or past smoker). In time dependent Cox regression analysis, because smoking status could be changed in each screening programs, smoking status at event time was used for three categories in extended (time varying) Cox regression. Three categories were 'never smoking', 'past smoking' and 'current smoking'. 'Past smoking' refers only to those who quit smoking after the start date of the examination. Past smokers before the start date of the examination were washed out and treated as 'never smoking'. Only past smokers identified after the start of the examination were reflected as 'past smoking'. Since the duration as a 'past smoking' before the examination began is unknown, only 'past smoking' whose duration is known accurately were defined. Furthermore, it is suitable for short-term effects because it reflects the most recent situation. There could be some problems with the validity and consistency of answers. For example, in the previous screening, the examinee who answered as a 'past smoking' may answer as a 'never smoking' in the next health examination. To correct this, if the examinee, who answered as a 'current smoking' at least once in previous screenings, checked that he is a 'never smoking' in the next examination, the answer was all converted to a 'past smoking'. In sensitivity analysis, smoking status was divided into two groups ('smoking': current smoking, 'non smoking': never smoking or past smoking). If the participant did

not participate in the biennial health screening, the Last observation carried forward (LOCF) method was used to draw and use the results of the previous screening.

Assessment of outcome variable: unintentional injury death and other external causes of death

The external causes of death were assessed using Korean Standard Classification of Diseases (KCD) and the KCD was based on the International Classification of Diseases, 10th Revision (ICD-10). Information on death (date and cause of death) from Statistics Korea was individually linked using unique personal identification numbers. For the purpose of this study, one category was analyzed for external causes of death (V01-Y09), and the following 3 categories were considered: unintentional injury death (V01-X59), intentional self-harm (X60-X84), and homicide (X85-Y09). And once more, in unintentional injury death, 7 sub-categories were considered: transport accident (V01-V99), fall (W00-W19), drowning (W65-W74), suffocation (W75-W84), fire (X00-X09), poisoning (X40-X49) and other unintentional injury (W20-W64, W85-W99, X10-X39, X50-X59, Y10-Y89). Other unintentional injury includes ‘exposure to mechanical forces’, ‘exposure to electric current, radiation and extreme ambient air temperature and pressure’, ‘contact with heat’, ‘contact with venomous animals and plants’, ‘exposure to forces of nature’, overexertion’, ‘event of undetermined intent’, ‘operations of war’, ‘complications of medical and surgical care’, ‘sequelae of external causes of morbidity and mortality’, etc.

Assessment of covariates

In the NHIS-HEALS, all participants provided their socioeconomic and demographic factors, income-based insurance contributions, disability, variables for specific health problems and risk factors from questionnaires including frequency per week of alcohol drinking and clinical laboratory results including blood pressure, and fasting glucose.[28] And NHIS-HEALS also include healthcare usage data base which was based on data collected during the process of claiming healthcare services and included information on records of inpatient and outpatient usage (diagnosis, length of stay, treatment costs and services received) and prescription records (drug code, days prescribed and daily dosage).[28] We could calculate the Charlson comorbidity index (CCI) score through these data. Charlson comorbidity index was determined by evaluating and scoring for comorbid conditions including myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, rheumatologic disease, peptic ulcer disease, mild liver disease, diabetes, cerebrovascular event, moderate-to-severe renal disease, diabetes with chronic complications, cancer without metastases, leukemia, lymphoma, moderate or severe liver disease, metastatic solid tumor, acquired immune-deficiency syndrome. Apart from CCI, hypertension and diabetes were set as separate covariates based on past studies that were independently associated with external causes of death.[29,30] Some studies used the modified Charlson comorbidity index score excluding diabetes in this case. We also conducted the sensitivity analysis using the modified CCI score. However, only a small difference of 0.01 or less was shown from the result of the hazard ratio of main analysis. So, only the main analysis was included in the results. In addition, the definition of diabetes we used is 'fasting blood sugar higher than 126' in screening, which is different from the definition of 'diabetes diagnosis' used in CCI. So it would be more appropriate to use CCI containing diabetes, and further adjust the 'blood sugar control status'. Previous studies on the association between diabetes and external causes of death show that patients with diabetes who cannot control blood sugar have an increased risk of accident due to excessive

use of insulin, hypoglycemia, decreased consciousness due to ketoacidosis, and vision restrictions due to diabetic retinopathy.[30]

Alcohol drinking status was categorized into ‘never’, ‘2-3 times/month’, ‘1-2 times/week’, ‘3-4 times/week’, ‘every day’. Hypertension was defined when systolic blood pressure was greater than 140 or diastolic blood pressure was greater than 90 in the baseline screening programs. Diabetes mellitus was defined when fasting blood sugar was higher than 126 in the baseline screening programs. Charlson comorbidity index score was categorized into ‘0’, ‘1’, ‘≥2’. Income level was defined using income-based insurance contributions (a proxy for income) and categorized into ‘0’ (lowest, medical care), ‘1-3’ (low), ‘4-6’ (middle), ‘7-10’ (high). Disability degree was categorized into ‘Non-disabled’, ‘severe’ (class 1-2), ‘mild’ (class 3-6). The severity of disability was measured based on the 'Disability Rating Table of Persons with Disabilities' of the Welfare of Persons with Disabilities Act.

3. *Statistical analyses*

Descriptive analyses and Cox proportional-hazards model

We used the chi-square test for categorical variables to compare the baseline characteristics of participants by smoking status. We used Kaplan-Meier survival curves and log-log survival plot to check proportional hazard assumption. And we also used a Cox proportional-hazards model to estimate the associations between baseline smoking status and external causes of death. The model evaluated whether smoking status affects the survival time of external causes of death, and Hazard ratios (HR) with 95% confidence intervals (CIs) were calculated. Potential common confounding

factors were chosen based on the literature review: age,[31] alcohol drinking status,[32,33] hypertension,[29] diabetes Mellitus,[30] CCI score (from 1 year before baseline),[34] Income level,[35] disability degree.[36-38] All adjusted covariates were obtained from baseline survey data. Covariates which do not satisfy proportional hazard assumption was stratified in each analysis, which were different in each analysis. However, the analysis results before and after stratification hardly changed. So only the results after stratification were presented. Men and women have different smoking patterns hence we conducted all analysis separately. We used Fine-Gray competing risk model which was developed to take competing risks into account, which provides a better estimation for the risk of the main outcome of interest when one or more competing risks are presented.[39,40] All deaths other than those to be analyzed were classified as competing risk.

Extended (time-dependent) Cox regression model

We used time-dependent Cox regression models (SAS PROC PHREG) to consider the time-varying smoking status which could change over time during the follow-up period.[41,42] For this we organized the data in a counting process style which consists of several rows per each participant.[43] Total rows were 3,063,306 for 493,031 participants. The exposure variable, smoking status, was categorized as never smoking, past smoking and current smoking. In sensitivity analysis, it was dichotomized (smoking or non smoking, regardless of baseline smoking status) and change was checked in all recordings of screening programs in each participant. We used last observation carried forward (LOCF) methods for missing records of screening and it was assumed that the smoking status at previous screening was maintained until the next screening date. The factors adjusted in the

time-varying Cox regression analyses were the same as those in the Cox proportional-hazards analyses.

Sensitivity analyses

First, we conducted sensitivity analyses with smoking status dichotomized as 'Non smoker' and 'Current smoker', instead of three categories. Non smoker means sum of never smoker and past smoker at baseline screening. Additionally, we used age as the time scale, instead of covariate, and take age 40 as the origin point for the analysis of survival time in elders (40-79 years old in our study at baseline). Thus, this approach directly takes into account the age effect on mortality, adjusting automatically for the confounding effect of age.

Finally, we analyzed whether there was a dose response relationship between 'smoking intensity', and unintentional injury death in time-dependent Cox regression. The analyses were conducted only in subgroups that were statistically significant in the main analysis. 'Smoking intensity' was categorized as 'never smoking', 'past smoking', 'current smoking (< 1 pack/day)', 'current smoking (≥ 1 pack/day)', and 'current smoking (unknown). 'Smoking intensity' were obtained from baseline survey data.

All statistical analyses were performed using SAS software version 9.4 (SAS Institute, Inc., Cary, NC, USA). A two-sided P-value of <0.05 was considered significant.

Ethics

After the National Health Insurance Service (NHIS) review committee reviewed the ethics approval and research proposal, we had the permission to use the NHIS-HEALS (NHIS-2021-2-085). The requirement for informed consent was waived as the NHIS-HEALS database was constructed after anonymization according to strict confidentiality guidelines. This study was approved by the institutional review board of Severance Hospital at Yonsei University College of Medicine (Y-2020-0176).

III. RESULTS

1. *Baseline characteristics of the study participants according to smoking status*

Table 1 presents the descriptive characteristics of study participants stratified according to the smoking status at first health screening in 2002-2003. The male participants in current smoker were more likely to be younger, non-disabled, have more alcohol drinking, have diabetes mellitus, have lower CCI score and have lower income level than never smoker and past smoker. In female, current smoker were more likely to be older, have more alcohol drinking, have diabetes mellitus, have higher CCI score, and have lower income level than never smoker and past smoker. Especially, the age distribution was completely different between men and women. In women, past smoker was only 1.0% and current smoker was only 2.9%. Whereas, in men, past smoker was 15.6% and current smoker was 42.1%. No statistical differences were observed in hypertension and disability degree at baseline among smoking status groups in women.

Table 1. Baseline characteristics of study participants by smoking status

Variable	Men (n=266,239)				Women (n=226,792)			
	Never smoker (n=112,577)	Past smoker (n=41,519)	Current smoker (n=112,143)	p-value	Never smoker (n=218,146)	Past smoker (n=2,170)	Current smoker (n=6,476)	p-value
Age (y)								
40-49	46,597 (41.4)	21,176 (51.0)	62,409 (55.7)	<0.0001	93,380 (42.8)	999 (46.0)	2,409 (37.2)	<0.0001
50-59	33,173 (29.5)	11,486 (27.7)	29,879 (26.6)		62,273 (28.6)	500 (23.0)	1,438 (22.2)	
60-69	25,026 (22.2)	6,604 (15.9)	16,044 (14.3)		47,211 (21.6)	419 (19.3)	1,603 (24.8)	
70-79	7,781 (6.9)	2,253 (5.4)	3,811 (3.4)		15,282 (7.0)	252 (11.6)	1,026 (15.8)	
Alcohol drinking status								
Never	57,136 (50.8)	11,109 (26.8)	25,411 (22.7)	<0.0001	182,535 (83.7)	987 (45.5)	3,573 (55.2)	<0.0001
2-3 times/month	18,636 (16.6)	10,055 (24.2)	22,219 (19.8)		21,468 (9.8)	837 (38.6)	1,133 (17.5)	
1-2 times/week	21,907 (19.5)	12,034 (29.0)	34,844 (31.1)		10,252 (4.7)	192 (8.9)	1,026 (15.8)	
3-4times/week	8,710 (7.7)	5,145 (12.4)	18,003 (16.1)		1,887 (0.9)	67 (3.1)	423 (6.5)	
Every day	5,701 (5.1)	2,815 (6.8)	11,438 (10.2)		1,431 (0.7)	39 (1.8)	280 (4.3)	
N/A	487 (0.4)	361 (0.9)	228 (0.2)		573 (0.3)	48 (2.2)	41 (0.6)	
Hypertension								
No	67,822 (60.2)	25,817 (62.2)	71,361 (63.6)	<0.0001	152,618 (70.0)	1,515 (69.8)	4,611 (71.2)	0.2180
Yes	44,710 (39.7)	15,695 (37.8)	40,748 (36.3)		65,420 (30.0)	654 (30.1)	1,860 (28.7)	
N/A	45 (0.0)	7 (0.0)	34 (0.0)		108 (0.1)	1 (0.1)	5 (0.1)	
Diabetes Mellitus								
No	102,196 (90.8)	37,904 (91.3)	101,094 (90.2)	<0.0001	204,140 (93.6)	2,026 (93.4)	5,888 (90.9)	<0.0001
Yes	10,252 (9.1)	3,572 (8.6)	10,947 (9.8)		13,672 (6.3)	144 (6.6)	577 (8.9)	
N/A	129 (0.1)	43 (0.1)	102 (0.1)		334 (0.2)	0 (0.0)	11 (0.2)	
CCI score (1 yr before baseline)								
0	75,734 (67.3)	28,733 (69.2)	83,145 (74.1)	<0.0001	132,227 (60.6)	1,254 (57.8)	3,650 (56.4)	<0.0001
1	22,765 (20.2)	8,054 (19.4)	19,143 (17.1)		53,288 (24.4)	539 (24.8)	1,714 (26.5)	
≥2	14,078 (12.5)	4,732 (11.4)	9,855 (8.8)		32,631 (15.0)	377 (17.4)	1,112 (17.2)	
Income level (decile & medical care)								
0 (lowest, medical care)	61 (0.1)	20 (0.1)	84 (0.1)	<0.0001	291 (0.1)	6 (0.3)	32 (0.5)	<0.0001
1-3	19,859 (17.6)	5,974 (14.3)	22,544 (20.1)		61,732 (28.3)	624 (28.8)	2,380 (36.8)	
4-6	24,558 (21.8)	8,151 (19.6)	28,112 (25.1)		51,100 (23.4)	553 (25.5)	1,789 (27.6)	
7-10	68099 (60.5)	27,401 (66.0)	61,403 (54.8)		105,023 (48.1)	987 (45.5)	2,275 (35.1)	
Disability degree								
Non-disabled	111,458 (99.0)	41,251 (99.4)	111,522 (99.5)	<0.0001	217,412 (99.7)	2,159 (99.5)	6443 (99.5)	0.1151

Severe (class 1-2)	431 (0.4)	112 (0.3)	214 (0.2)	304 (0.1)	5 (0.2)	13 (0.2)
Mild (class 3-6)	688 (0.6)	156 (0.4)	407 (0.4)	430 (0.2)	6 (0.3)	20 (0.3)

Values are presented as number (%).
CCI = Charlson comorbidity index; N/A = not available (due to missing data).

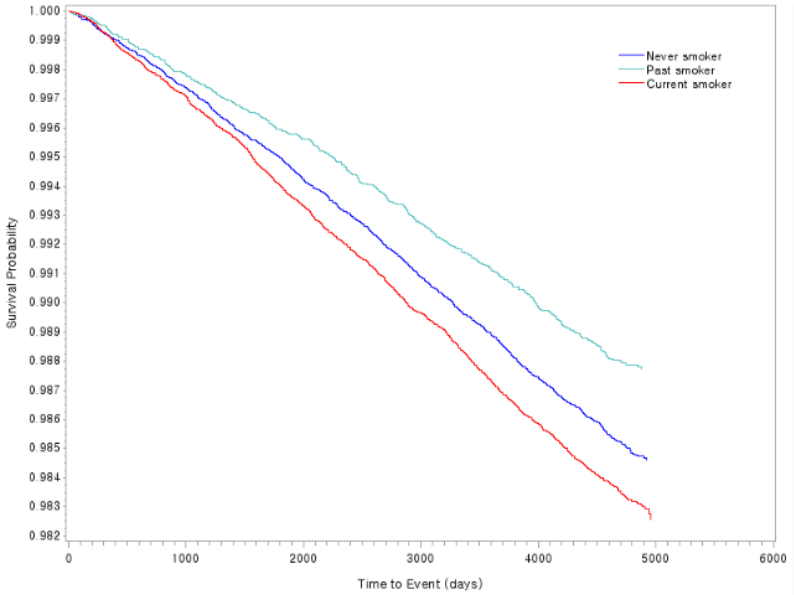
2. *Kaplan-Meier survival curves and log-log survival plot for proportional hazards assumption check stratified by baseline smoking status*

Figure 3 and 4 shows the Kaplan-Meier survival plot (A) and log-log survival plot (B) for proportional hazards assumption check stratified by baseline smoking status for external causes of death in men and women, respectively. Figure 5 and 6 shows the Kaplan-Meier survival plot (A) and log-log survival plot (B) for unintentional injury death.

In appendix Figure 1 and 2 shows the Kaplan-Meier survival plot (A) and log-log survival plot (B) for proportional hazards assumption check stratified by baseline smoking status for external causes of death in men and women using age as time scale, which means the survival plots were adjusted for age. Appendix Figure 3 and 4 shows the Kaplan-Meier survival plot (A) and log-log survival plot (B) for unintentional injury death using age as time scale, which means the survival plots were adjusted for age. In Figure 3 and 4, external causes of death and unintentional injury death of men, the survival rate of past smoker seems to be better than that of never smoker, but there is no difference after age adjustment (Appendix Figure 1 and 2). On the other hand, in women, the survival rate decreases in the order of never smoker, past smoker, and current smoker after age adjustment. (Appendix Figure 3 and 4).

In goodness of fit test, all p-value was greater than 0.05, suggest that the PH assumption is reasonable for external causes of death and unintentional injury death both in men and women. But in graphical techniques, the log-log survival plots were not parallel in part, which means the assumption was not satisfied, which could be subjective in interpretation. Therefore, extended Cox models using the time-dependent smoking status were also used with standard Cox proportional models using baseline smoking status.

A)



B) with zph 0.8088(past smoker) and 0.3652(current smoker)

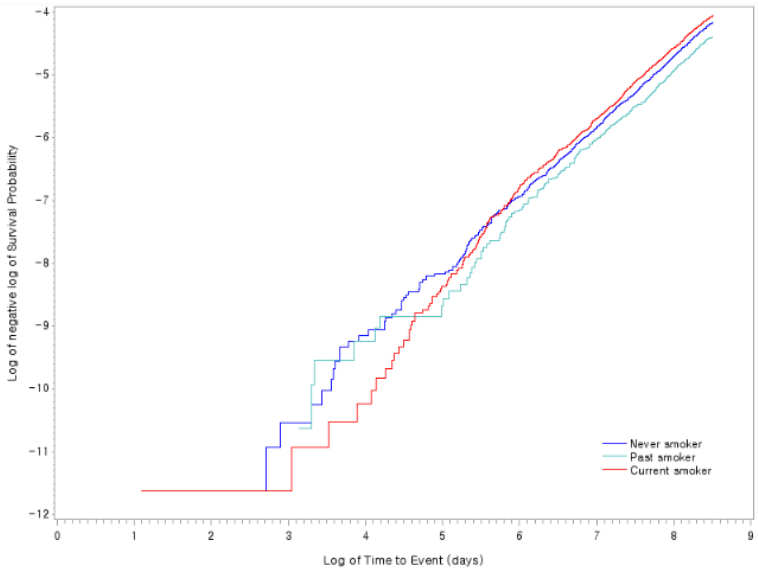
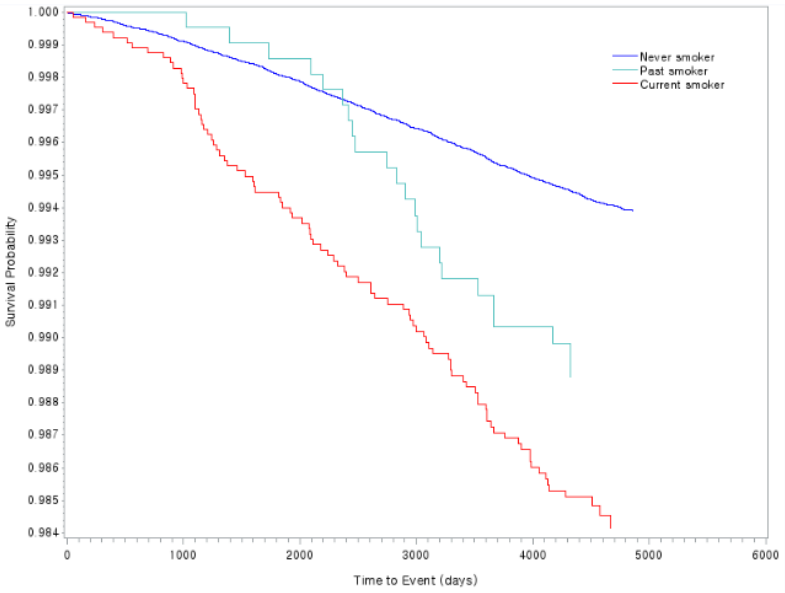


Figure 3. Survival plot (A) and log-log survival plot (B)

stratified by baseline smoking status for external causes of death in men

A)



B) with zph 0.1583(past smoker) and 0.3697(current smoker)

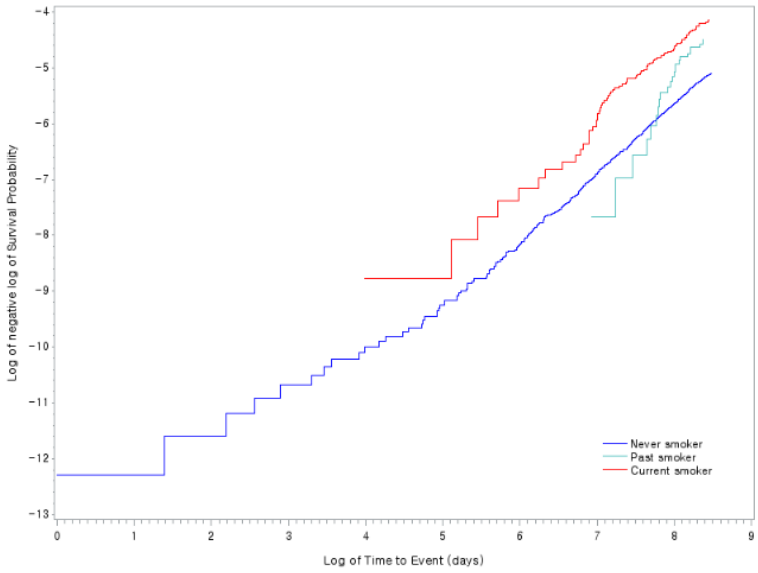
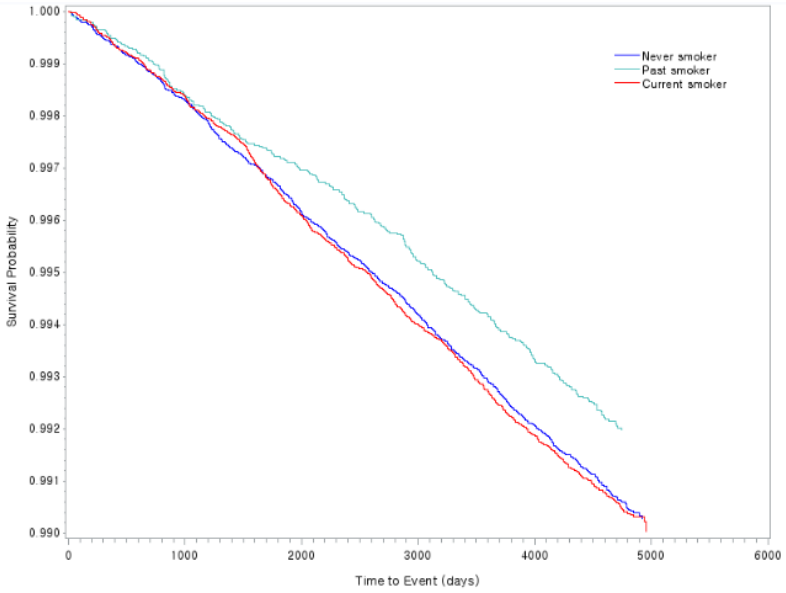


Figure 4. Survival plot (A) and log-log survival plot (B)

stratified by baseline smoking status for external causes of death in women

A)



B) with zph 0.6865(past smoker) and 0.9555(current smoker)

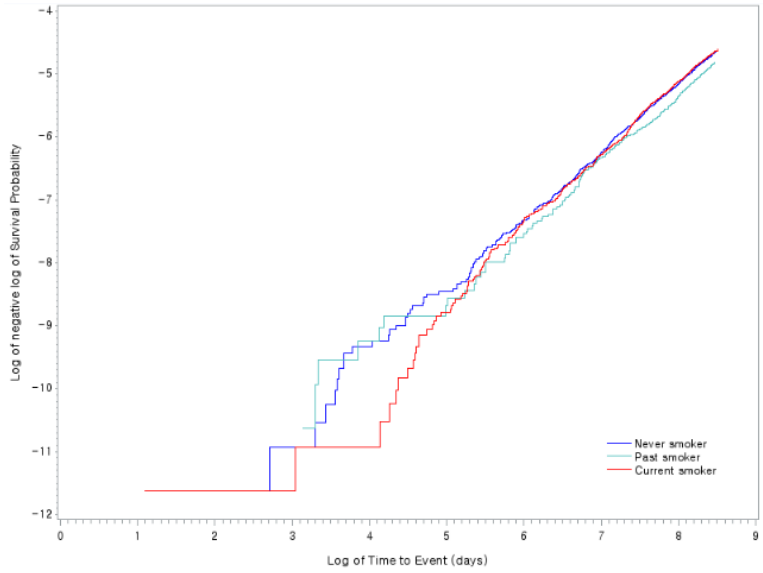
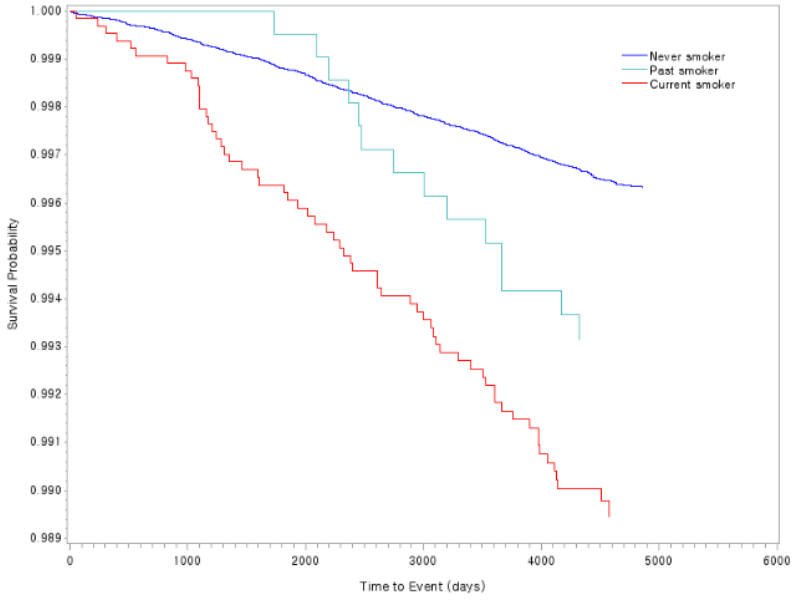


Figure 5. Survival plot (A) and log-log survival plot (B)

stratified by baseline smoking status for unintentional injury death in men

A)



B) with zph 0.1267(past smoker) and 0.6680(current smoker)

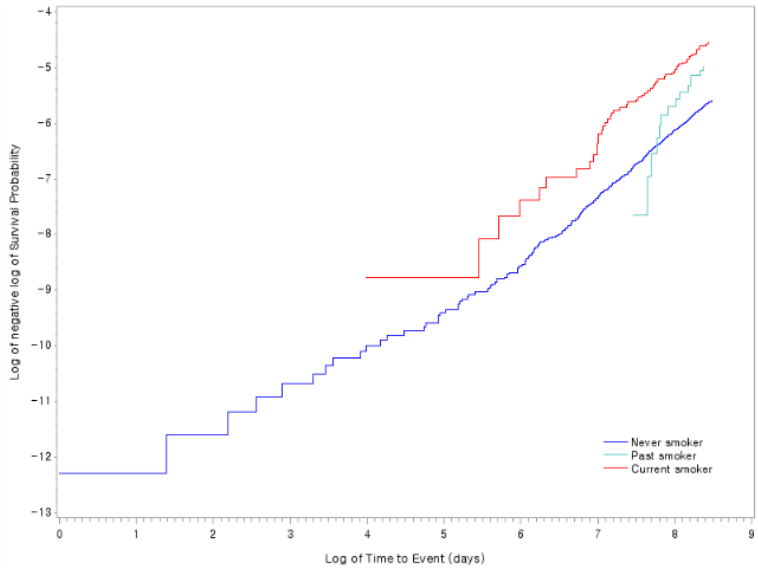


Figure 6. Survival plot (A) and log-log survival plot (B)

stratified by baseline smoking status for unintentional injury death in women

3. *Associations between baseline smoking status and external causes of death*

Table 2-1 and Table 2-2 present the association between baseline smoking status and external causes of death. In men, 128.7 of external causes of death cases were occurred by 100,000 person-years in the baseline current smoker and 92.4 cases occurred by 100,000 person-years in the baseline past smoker. Whereas 115.1 of external causes of death cases occurred by 100,000 person-years in the baseline never smoker. After full adjustments for demographic, biological, and lifestyle factors, only current smoker was associated with external causes of death in men (HR=1.25, 95%CI=1.16-1.34). Current smoker was also associated with unintentional injury death in men (HR=1.14, 95%CI=1.04-1.25), but not in past smoker (HR=0.96, 95%CI=0.84-1.09). In men, current smoker was positively associated with intentional self-harm (HR=1.44, 95%CI=1.28-1.61), but past smoker was negatively associated with intentional self-harm (HR=0.82, 95%CI=0.68-0.98).

In women, 121.9 of external causes of death cases were occurred by 100,000 person-years in the baseline current smoker and 87.0 cases occurred by 100,000 person-years in the baseline past smoker. Whereas 46.2 of external causes of death cases occurred by 100,000 person-years in the baseline never smoker. After adjustments, not only current smoker (HR=1.85, 95%CI=1.49-2.30)., but also past smoker (HR=1.65, 95%CI=1.09-2.51) was associated with external causes of death. Current smoker was also associated with unintentional injury death (HR=1.95, 95%CI=1.50-2.54), and past smoker was associated with unintentional injury death (HR=1.72, 95%CI=1.01-2.91). Only current smoker was associated with intentional self-harm (HR=1.60, 95%CI=1.08-2.38). No significant association between smoking status and homicide was found both in men and women.

Sensitivity analyses using age as time scale were similar to the main results (Appendix Table 1-1, 1-2) and sensitivity analyses with two categories of baseline smoking status (Appendix Table 3-1, 3-2) were also similar to the results of the current smoker in main table.

Table 2-1. Associations between baseline smoking status and external causes of death in men

Death	Baseline smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	HR (95% CI)	
					unadjusted	adjusted*
External causes of death	Never smoker	1,377,462	1,585	115.1	ref	ref
	Past smoker	513,160	474	92.4	0.81 (0.73-0.89)	0.92 (0.83-1.02)
	Current smoker	1,371,152	1,764	128.7	1.12 (1.04-1.19)	1.25 (1.16-1.34)
Unintentional injury death	Never smoker	1,377,462	996	72.3	ref	ref
	Past smoker	513,160	311	60.6	0.84 (0.74-0.96)	0.96 (0.84-1.09)
	Current smoker	1,371,152	1,004	73.2	1.01 (0.93-1.10)	1.14 (1.04-1.25)
Intentional self-harm death	Never smoker	1,377,462	575	41.7	ref	ref
	Past smoker	513,160	156	30.4	0.73 (0.61-0.87)	0.82 (0.68-0.98)
	Current smoker	1,371,152	744	54.3	1.30 (1.16-1.45)	1.44 (1.28-1.61)
Homicide	Never smoker	1,377,462	14	1.0	ref	ref
	Past smoker	513,160	7	1.4	1.35 (0.55-3.35)	1.32 (0.50-3.46)
	Current smoker	1,371,152	16	1.2	1.15 (0.56-2.35)	0.88 (0.39-2.00)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree, and stratified for covariates which do not satisfy proportional hazard assumption.
HR = Hazard ratio; CI = confidence interval.

Table 2-2. Associations between baseline smoking status and external causes of death in women

Death	Baseline smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	HR (95% CI)	
					unadjusted	adjusted*
External causes of death	Never smoker	2,708,203	1,250	46.2	ref	ref
	Past smoker	26,448	23	87.0	1.86 (1.23-2.80)	1.65 (1.09-2.51)
	Current smoker	76,311	93	121.9	2.53 (2.05-3.12)	1.85 (1.49-2.30)
Unintentional injury death	Never smoker	2,708,203	755	27.9	Ref	ref
	Past smoker	26,448	14	52.9	1.87 (1.10-3.17)	1.72 (1.01-2.91)
	Current smoker	76,311	62	81.2	2.79 (2.15-3.61)	1.95 (1.50-2.54)
Intentional self-harm death	Never smoker	2,708,203	468	17.3	ref	ref
	Past smoker	26,448	9	34.0	1.94 (1.002-3.75)	1.65 (0.84-3.24)
	Current smoker	76,311	28	36.7	2.03 (1.39-2.97)	1.60 (1.08-2.38)
Homicide	Never smoker	2,708,203	27	1.0	ref	ref
	Past smoker	26,448	0	0.0	0	0
	Current smoker	76,311	3	3.9	3.76 (1.14-12.38)	2.89 (0.91-9.17)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree, and stratified for covariates which do not satisfy proportional hazard assumption.
HR = Hazard ratio; CI = confidence interval.

4. *Associations between baseline smoking status and subgroup of unintentional injury death*

Table 3-1 and Table 3-2 present association between baseline smoking status and subgroup of unintentional injury death in men and women, respectively. The total number of unintentional injury death in men was 2,311. The number of subgroup of unintentional injury death in men was the highest in transport accident (1,082, 47%), followed by other unintentional injury (656, 28%), fall (366, 16%), drowning (94, 4%), suffocation (59, 3%), poisoning (29, 1%), and fire (25, 1%). The total number of unintentional injury death in women was 831. The number of subgroups of unintentional injury death in women was the highest in transport accident (363, 44%), followed by other unintentional injury (289, 35%), fall (95, 11%), suffocation (31, 4%), drowning (24, 3%), fire (18, 2%), and poisoning (11, 1%).

In men, after full adjustments and stratifications for demographic, biological, and lifestyle factors, current smoker was associated with only suffocation death (HR=2.41, 95%CI=1.38-4.21). However, past smoker was not associated with any kind of subgroup of unintentional injury death. In women, current smoker was associated with fall death (HR=2.59, 95%CI=1.29-5.21) and other unintentional injury death (HR=2.54, 95%CI=1.73-3.74). Past smoker was not associated with any kind of subgroup of unintentional injury death. In some subgroup of unintentional injury death, the number of deaths was less than three, hence HR was not available.

Sensitivity analyses using age as time scale results (Appendix Table 2-1 and 2-2) were similar to the results of the current smoker in main table, except association between current smoker and other unintentional injury death (HR=2.59, 95%CI=1.29-5.21). Sensitivity analyses with two categories

of baseline smoking status (Appendix Table 4-1 and 4-2) were also similar to the results of the current smoker in main table.

Table 3-1. Associations between baseline smoking status and subgroup of unintentional injury death in men

Death	Baseline smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	HR (95% CI)	
					unadjusted	adjusted*
Transport accident	Never smoker	1,377,462	479	34.8	ref	ref
	Past smoker	513,160	142	27.7	0.80 (0.67-0.97)	0.90 (0.75-1.09)
	Current smoker	1,371,152	461	33.6	0.97 (0.85-1.10)	1.04 (0.91-1.19)
Fall	Never smoker	1,377,462	156	11.3	ref	ref
	Past smoker	513,160	57	11.1	0.99 (0.73-1.34)	1.14 (0.84-1.55)
	Current smoker	1,371,152	153	11.2	0.98 (0.79-1.23)	1.21 (0.96-1.52)
Drowning	Never smoker	1,377,462	35	2.5	ref	ref
	Past smoker	513,160	9	1.8	0.70 (0.34-1.45)	0.70 (0.34-1.45)
	Current smoker	1,371,152	50	3.6	1.43 (0.93-2.21)	1.35 (0.85-2.14)
Suffocation	Never smoker	1,377,462	19	1.4	ref	ref
	Past smoker	513,160	7	1.4	0.996 (0.42-2.37)	1.24 (0.51-3.00)
	Current smoker	1,371,152	33	2.4	1.74 (0.99-3.06)	2.41 (1.38-4.21)
Fire	Never smoker	1,377,462	9	0.7	ref	ref
	Past smoker	513,160	3	0.6	0.90 (0.24-3.31)	1.02 (0.30-3.50)
	Current smoker	1,371,152	13	0.9	1.44 (0.62-3.37)	1.63 (0.73-3.64)
Poisoning	Never smoker	1,377,462	14	1.0	ref	ref
	Past smoker	513,160	2	0.4	N/A	N/A
	Current smoker	1,371,152	13	0.9	0.93 (0.44-1.98)	1.04 (0.44-2.45)
Other unintentional injury	Never smoker	1,377,462	284	20.6	ref	ref
	Past smoker	513,160	91	17.7	0.87 (0.68-1.10)	0.998 (0.79-1.27)
	Current smoker	1,371,152	281	20.5	0.99 (0.84-1.17)	1.17 (0.99-1.40)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree, and stratified for covariates which do not satisfy proportional hazard assumption.
If number of events is less than three, HR (95% CI) is presented as N/A.
HR = Hazard ratio; CI = confidence interval; N/A = not available.

Table 3-2. Associations between baseline smoking status and subgroup of unintentional injury death in women

Death	Baseline smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	HR (95% CI)	
					unadjusted	adjusted*
Transport accident	Never smoker	2,708,203	343	12.7	ref	ref
	Past smoker	26,448	5	18.9	1.47 (0.61-3.55)	1.62 (0.67-3.93)
	Current smoker	76,311	15	19.7	1.48 (0.88-2.48)	1.26 (0.75-2.09)
Fall	Never smoker	2,708,203	85	3.1	ref	ref
	Past smoker	26,448	1	3.8	N/A	N/A
	Current smoker	76,311	9	11.8	3.59 (1.81-7.13)	2.59 (1.29-5.21)
Drowning	Never smoker	2,708,203	20	0.7	ref	ref
	Past smoker	26,448	1	3.8	N/A	N/A
	Current smoker	76,311	3	3.9	5.07 (1.51-17.06)	3.65 (0.89-15.05)
Suffocation	Never smoker	2,708,203	29	1.1	ref	Ref
	Past smoker	26,448	1	3.8	N/A	N/A
	Current smoker	76,311	1	1.3	N/A	N/A
Fire	Never smoker	2,708,203	15	0.6	ref	Ref
	Past smoker	26,448	0	0.0	0	0
	Current smoker	76,311	3	3.9	6.75 (1.95-23.31)	3.35 (0.85-13.23)
Poisoning	Never smoker	2,708,203	11	0.4	ref	ref
	Past smoker	26,448	0	0.0	0	0
	Current smoker	76,311	0	0.0	0	0
Other unintentional injury	Never smoker	2,708,203	252	9.3	ref	ref
	Past smoker	26,448	6	22.7	2.40 (1.07-5.39)	1.90 (0.83-4.35)
	Current smoker	76,311	31	40.6	4.17 (2.87-6.05)	2.54 (1.73-3.74)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree, and stratified for covariates which do not satisfy proportional hazard assumption.
If number of events is less than three, HR (95% CI) is presented as N/A.
HR = Hazard ratio; CI = confidence interval; N/A = not available.

5. *Associations between time-dependent smoking status and external causes of death*

Table 4-1 and Table 4-2 present association between time-dependent smoking status and external causes of death. In men, 134.0 of external causes of death cases were occurred by 100,000 person-years in the current smoking group and 108.9 cases occurred by 100,000 person-years in the past smoking group. Whereas 108.1 of external causes of death cases occurred by 100,000 person-years in the never smoking group. In unintentional injury death in men, 75.0 cases occurred by 100,000 person-years in the current smoking group, 65.8 cases in the past smoking group and 69.4 cases in the never smoking group. After full adjustments, only current smoking group was associated with external causes of death (HR=1.44, 95%CI=1.34-1.54), and unintentional injury death (HR=1.27, 95%CI=1.16-1.39) in men. But in women, both current smoking group and past smoking group were associated with external causes of death (HR=1.64, 95%CI=1.28-2.11; HR=1.82, 95%CI=1.32-2.52, respectively), and unintentional injury death (HR=1.61, 95%CI=1.17-2.21; HR=1.96, 95%CI=1.31-2.93, respectively). HRs were even higher in past smoking group than current smoking group.

In men, current smoking group (HR=1.76, 95%CI=1.57-1.97) and past smoking group (HR=1.20, 95%CI=1.02-1.42) were associated with intentional self-harm. But in women, only current smoking group (HR=1.67, 95%CI=1.06-2.57) was associated with intentional self-harm. Homicide had no association with smoking status. Or the number of homicide deaths was less than three, hence HR was not available.

Sensitivity analyses with two categories of time-dependent smoking status (Appendix Table 6-1 and 6-2) were similar to the results of the current smoking group in main table.

Table 4-1. Associations between smoking status and external causes of death using time-dependent Cox regression in men

Death	Smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	HR (95% CI)	
					unadjusted	adjusted*
External causes of death	Never smoking	1,667,277	1,802	108.1	ref	ref
	Past smoking	461,886	503	108.9	0.96 (0.87-1.07)	1.11 (0.998-1.22)
	Current smoking	1,132,610	1,518	134.0	1.25 (1.16-1.33)	1.44 (1.34-1.54)
Unintentional injury death	Never smoking	1,667,277	1,157	69.4	ref	ref
	Past smoking	461,886	304	65.8	0.92 (0.81-1.04)	1.07 (0.94-1.21)
	Current smoking	1,132,610	850	75.0	1.08 (0.99-1.18)	1.27 (1.16-1.39)
Intentional self-harm death	Never smoking	1,667,277	626	37.5	Ref	ref
	Past smoking	461,886	197	42.7	1.06 (0.90-1.25)	1.20 (1.02-1.42)
	Current smoking	1,132,610	652	57.6	1.54 (1.38-1.72)	1.76 (1.57-1.97)
Homicide	Never smoking	1,667,277	19	1.1	ref	ref
	Past smoking	461,886	2	0.4	N/A	N/A
	Current smoking	1,132,610	16	1.4	1.23 (0.63-2.40)	0.95 (0.46-1.99)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree.
If number of events is less than three, HR (95% CI) is presented as N/A.
HR = Hazard ratio; CI = confidence interval; N/A = not available.

Table 4-2. Associations between smoking status and external causes of death using time-dependent Cox regression in women

Death	Smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	HR (95% CI)	
					unadjusted	adjusted*
External causes of death	Never smoking	2,713,692	1,262	46.5	ref	ref
	Past smoking	33,757	38	112.6	2.22 (1.61-3.07)	1.82 (1.32-2.52)
	Current smoking	63,513	66	103.9	2.24 (1.75-2.87)	1.64 (1.28-2.11)
Unintentional injury death	Never smoking	2,713,692	765	28.2	ref	ref
	Past smoking	33,757	25	74.1	2.43 (1.63-3.63)	1.96 (1.31-2.93)
	Current smoking	63,513	41	64.6	2.29 (1.67-3.13)	1.61 (1.17-2.21)
Intentional self-harm death	Never smoking	2,713,692	470	17.3	Ref	ref
	Past smoking	33,757	12	35.5	1.84 (1.03-3.28)	1.57 (0.88-2.80)
	Current smoking	63,513	23	36.2	2.11 (1.39-3.20)	1.67 (1.06-2.57)
Homicide	Never smoking	2,713,692	27	1.0	ref	ref
	Past smoking	33,757	1	3.0	N/A	N/A
	Current smoking	63,513	2	3.1	N/A	N/A

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree.
If number of events is less than three, HR (95% CI) is presented as N/A.
HR = Hazard ratio; CI = confidence interval; N/A = not available.

6. *Associations between time-dependent smoking status and subgroup of unintentional injury death*

Table 5-1 and 5-2 presents association between time-dependent smoking status and subgroup of unintentional injury death in men and women, respectively. In men, after full adjustments, current smoking group was associated with transport accident (HR=1.17, 95%CI=1.03-1.33), suffocation (HR=1.97, 95%CI=1.15-3.40), and other unintentional injury death (HR=1.36, 95%CI=1.14-1.62). past smoking group was associated with only suffocation (HR=2.14, 95%CI=1.06-4.35). In women, current smoking group was associated with only other unintentional injury death (HR=1.91, 95%CI=1.17-3.11). past smoking group was also associated only with other unintentional injury death (HR=2.87, 95%CI=1.68-4.90).

Sensitivity analyses with two categories of time-dependent smoking status (Appendix Table 7-1 and 7-2) were similar to the results of the current smoking group in main table. But in sensitivity analyses, smoking was associated with also poisoning (HR=2.25, 95%CI=1.02-4.94) in men.

Table 5-1. Associations between smoking status and subgroup of unintentional injury death using time-dependent Cox regression in men

Death	Smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	HR (95% CI)	
					unadjusted	adjusted*
Transport accident	Never smoking	1,248,134	437	35.0	ref	ref
	Past smoking	881,029	246	27.9	0.85 (0.70-1.03)	0.95 (0.78-1.15)
	Current smoking	1,132,610	399	35.2	1.05 (0.93-1.20)	1.17 (1.03-1.33)
Fall	Never smoking	1,248,134	146	11.7	ref	ref
	Past smoking	881,029	94	10.7	0.86 (0.62-1.19)	1.03 (0.74-1.44)
	Current smoking	1,132,610	126	11.1	0.96 (0.77-1.21)	1.17 (0.93-1.47)
Drowning	Never smoking	1,248,134	31	2.5	ref	ref
	Past smoking	881,029	23	2.6	1.37 (0.76-2.49)	1.42 (0.77-2.59)
	Current smoking	1,132,610	40	3.5	1.50 (0.97-2.34)	1.50 (0.94-2.40)
Suffocation	Never smoking	1,248,134	18	1.4	ref	ref
	Past smoking	881,029	18	2.0	1.59 (0.77-3.28)	2.14 (1.06-4.35)
	Current smoking	1,132,610	23	2.0	1.43 (0.81-2.53)	1.97 (1.15-3.40)
Fire	Never smoking	1,248,134	7	0.6	ref	ref
	Past smoking	881,029	6	0.7	1.68 (0.55-5.14)	2.00 (0.63-6.40)
	Current smoking	1,132,610	12	1.1	1.95 (0.82-4.64)	2.29 (0.96-5.48)
Poisoning	Never smoking	1,248,134	13	1.0	ref	ref
	Past smoking	881,029	1	0.1	N/A	N/A
	Current smoking	1,132,610	15	1.3	1.68 (0.80-3.53)	2.02 (0.89-4.57)
Other unintentional injury	Never smoking	1,248,134	256	20.5	ref	ref
	Past smoking	881,029	165	18.7	0.95 (0.76-1.20)	1.17 (0.92-1.47)
	Current smoking	1,132,610	235	20.7	1.08 (0.91-1.28)	1.36 (1.14-1.62)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree.
If number of events is less than three, HR (95% CI) is presented as N/A.
HR = Hazard ratio; CI = confidence interval; N/A = not available.

Table 5-2. Associations between smoking status and subgroup of unintentional injury death using time-dependent Cox regression in women

Death	Smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	HR (95% CI)	
					unadjusted	adjusted*
Transport accident	Never smoking	2,689,698	342	12.7	ref	ref
	Past smoking	57,751	8	13.9	0.92 (0.34-2.47)	0.85 (0.32-2.26)
	Current smoking	63,513	13	20.5	1.57 (0.90-2.73)	1.32 (0.76-2.29)
Fall	Never smoking	2,689,698	85	3.2	ref	ref
	Past smoking	57,751	4	6.9	2.69 (0.84-8.65)	2.28 (0.71-7.30)
	Current smoking	63,513	6	9.4	2.95 (1.29-6.74)	2.13 (0.92-4.91)
Drowning	Never smoking	2,689,698	20	0.7	Ref	ref
	Past smoking	57,751	2	3.5	N/A	N/A
	Current smoking	63,513	2	3.1	N/A	N/A
Suffocation	Never smoking	2,689,698	29	1.1	Ref	ref
	Past smoking	57,751	2	3.5	N/A	N/A
	Current smoking	63,513	0	0.0	0	0
Fire	Never smoking	2,689,698	15	0.6	Ref	ref
	Past smoking	57,751	1	1.7	N/A	N/A
	Current smoking	63,513	2	3.1	N/A	N/A
Poisoning	Never smoking	2,689,698	11	0.4	Ref	ref
	Past smoking	57,751	0	0.0	0	0
	Current smoking	63,513	0	0.0	0	0
Other unintentional injury	Never smoking	2,689,698	250	9.3	Ref	ref
	Past smoking	57,751	21	36.4	3.90 (2.31-6.60)	2.87 (1.68-4.90)
	Current smoking	63,513	18	28.3	3.10 (1.92-5.01)	1.91 (1.17-3.11)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree.
If number of events is less than three, HR (95% CI) is presented as N/A.
HR = Hazard ratio; CI = confidence interval; N/A = not available.

7. *Associations between baseline smoking intensity and subgroup of unintentional injury death*

Appendix Table 9 presents distribution of smoking intensity at baseline screening. In smoking intensity, men had 27% missing and women had 25% missing at baseline screening. Appendix Table 10 presents the association between baseline smoking intensity and subgroup of unintentional injury death using time-dependent Cox regression in men and women. The analyses were conducted only in subgroups that were statistically significant in the main analysis. 'Never smoking group' and 'past smoking group' are same as those of main analysis in Table 5-1 and 5-2. Only 'current smoking group' was more categorized to 'current smoking (< 1 pack/day)', 'current smoking (≥ 1 pack/day)', and 'current smoking (unknown). When comparing only 'current smoking (< 1 pack/day)' and 'current smoking (≥ 1 pack/day)', there are dose-response relationship between smoking intensity and suffocation death (HR=2.08, 95%CI=1.11-3.89; HR=3.43, 95%CI=1.52-7.76), other unintentional injury death (HR=1.28, 95%CI=1.05-1.56; HR=1.45, 95%CI=1.07-1.97), but not in transport accident death (HR=1.24, 95%CI=1.07-1.43; HR=1.08, 95%CI=0.84-1.37) in men. In women, there are dose-response relationship between smoking intensity and other unintentional injury death (HR=2.10, 95%CI=1.23-3.59; HR=3.32, 95%CI=0.91-12.14), but not in fall death (HR=2.75, 95%CI=1.18-6.37; HR=N/A, 95%CI=N/A). But, all p for trend of HR in above subgroups were statistically significant among 'never smoking', 'past smoking', 'current smoking (< 1 pack/day)', 'current smoking (≥ 1 pack/day)'. P for trend was 0.0241 in men's transport accident death, 0.0007 in men's suffocation death, 0.0032 in men's other unintentional injury death, 0.0122 in women's fall death, and <0.0001 in women's other unintentional injury death, respectively.

IV. DISCUSSION

1. *Summary of findings*

We found longitudinal associations between smoking status and unintentional injury death and other external causes of death. In both sex, current smoker has higher risk of external causes of death, unintentional injury death and intentional self-harm than never smoker. When using time-dependent Cox regression, the result was similar. In subgroup of unintentional injury death, current smoker has higher risk of suffocation death in men, and higher risk of fall and other unintentional injury death in women than never smoker. In time-dependent Cox regression, current smoking at event time has higher risk of transport accident, suffocation, and other unintentional injury death in men, and higher risk of other unintentional injury death in women than never smoking. Among these statistically significant subgroups of unintentional death, there were dose-response relationships between baseline smoking intensity and subgroups of unintentional injury death, except transport accident. Past smoking at event time has higher risk of suffocation death in men and, and other unintentional injury death in women than never smoking. In summary, smoking is associated with increased risks of external causes of death, unintentional injury death, and intentional self-harm both in long-term and short-term.

2. *Baseline smoking status and time-dependent smoking status*

In current studies, baseline smoking status and time-dependent smoking status were used respectively. Relatively, baseline smoking status is suitable for viewing the long-term effects of smoking, and time-dependent smoking status is more suitable for viewing the short-term effects of

smoking.[42] Since smoking status can change continuously, it would be better to use time-dependent smoking status if we focus on change. This is a short-term impact. On the other hand, when looking at the long-term effects of smoking, an analysis focusing more on the baseline status than on change would be suitable. But there was no such big difference in results between two methods.

When we use time-dependent smoking status, 'past smoking' refers only to those who quit smoking after the start date of the examination. Past smokers before the start date of the examination were washed out and treated as 'never smoking'. Only past smokers identified after the start of the examination were reflected as 'past smoking'. Since the duration as a 'past smoking' before the examination began is unknown, only 'past smoking' whose duration is known accurately were defined. Furthermore, it is suitable for short-term effects because it reflects the most recent situation.

In NHIS-HEALS, questionnaires about smoking status, smoking duration and smoking intensity were included. But there could be some problems with the validity and consistency of answers. For example, in the previous screening, the examinee who answered as a 'past smoking' may answer as a 'never smoking' in the next health examination. To correct this, if the examinee, who answered as a 'current smoking' at least once in previous screenings, checked that he is a 'never smoking' in the next examination, the answer was all converted to a 'past smoking'.

3. *Left-truncated data with age as time scale*

The standard approach for survival analysis of the elderly population is to define the survival time as elapsed time from entry into the study until death, and to adjust by age using stratification and regression procedures.[44] But some studies suggested that the use of age as time scale is deemed more

appropriate for survival analysis of the elderly, although the use of standard survival analysis generally produces correct estimates.[44] In our study, we use both standard approach and alternative approach, because the age of participants at baseline was 40-79 years old. In the alternative approach, age minus 40 was taken as the time scale. In this approach, the time scale is age and not the time in the cohort. Thus, this approach directly takes into account the age effect on mortality, adjusting automatically for the confounding effect of age.[44] When we compare Figure 3 to 6 with Appendix Figure 1 to 4, we could find the age effect on mortality. In men, both in external causes of death and unintentional injury death, it could be seen that the survival rate of past smoker seems to be better than that of never smoker, but there is no difference after age adjustment. The difference in survival rates between past smokers and never smokers was due to age effects. On the other hand, in women, the survival rate decreases in the order of never smoker, past smoker, and current smoker after age adjustment.

In alternative approach, the Cox regression results were almost same with standard approach, which means the associations between baseline smoking status and external causes of death are maintained, excluding the effect of age. In time-dependent Cox regression, this alternative approach was not used, because this method could conceal the short-term effects of smoking on external causes of death.

4. Comparisons with previous studies

Meta-analysis of randomized controlled trials and cohort studies

There was a meta-analysis of randomized controlled trials about the association between smoking and external causes of death.[16] In this study, smoking cessation (intervention) was associated with reduced external causes of death (RR=0.65, 95%CI=0.36-1.19), unintentional injury death (RR=0.62, 95%CI=0.26-1.50), and intentional self-harm death (RR=0.48, 95%CI=0.16-1.42),[16] whereas, not with homicide (RR=1.25, 95%CI=0.33-4.64).[16] Another meta-analysis of four cohort studies showed that current smokers' adjusted external causes of death, unintentional injury death, transport accident death, and intentional self-harm death RRs were 1.42 (95%CI=0.99-2.05), 1.56 (95%CI=1.01-2.41), 1.83 (95%CI=0.97-3.44) and 1.36 (95%CI=0.60-3.12), respectively.[17] These results are similar to our study results.

Sex difference in subgroup analyses of unintentional injury death

There was a similar study in Taiwan with a total of 64,319 male participants which were followed up for 12-18 years using Cox proportional hazard model.[20] Age and alcohol use adjusted relative mortality risks for external causes (RR=1.69, 95%CI=1.39-2.05) including those from transport accident (RR=1.88, 95% CI=1.44-2.45) and non-transport accident (RR=1.48, 95%CI=1.11-1.99) were significantly higher for smokers than non-smokers.[20] Mortality was also increased for most subtypes of non-transport accident including fall, fire, and job-related injuries, but the increases were not significant except fall (RR=1.95, 95%CI=1.09-3.48) and job-related accidents (RR=2.91, 95%CI=1.004-8.42).[20] In our study, mortality for fall was also increased but increase was not significant (HR=1.21, 95%CI=0.96-1.52). Only suffocation was statistically significant (HR=2.41, 95%CI=1.38-4.21), which was not included in subtypes of non-transport accident in Taiwan study.

There was no significant association in past smokers, the same results in male participants in our study.

There was another study in Japan which examine the association between cigarette smoking and transport accident death among 97,078 adults (33,138 men and 63,940 women) aged 40-79 years at an annual health checkup in 1993.[45] They found a positive association, though marginally significant, between smoking and transport accident death among men in Japan, which was similar results of our study.[45] They also could not obtain adequate estimation among women, because of small number of deaths among female smokers.[45] As above, in most of the previous studies, women were often calculated in combination with men or not measured at all because the number of smokers was absolutely small.

In our study, almost all statistically significant hazard ratios were greater in women than in men. There could be several possible explanations for that. Since the mortality rate of never smokers as the reference group itself is so low in women, it is possible that the hazard ratio of current smokers and past smokers was relatively high. Another possible explanation is that women may have biological characteristics of being more sensitive to smoking than men. There were many studies about gender differences in smoking effects on diseases, and most studies suggested that women had a greater smoking effect on diseases.[46-49]

Previous studies in Korea

There exists a cross-sectional study which evaluated the association between cigarette smoking and unintentional non-fatal injuries among 230,715 Korean adults who participated in the 2009 Korea Community Health Survey. After adjusting for demographic characteristics, socioeconomic variables, lifestyle variables, and health status variables, past smokers (PRR=1.19, 95%CI=1.11-

1.28), light daily smokers (PRR=1.22, 95%CI=1.13-1.32), moderate daily smokers (PRR=1.33, 95%CI=1.24-1.42), and heavy daily smokers (PRR=1.40, 95%CI=1.25-1.57) had an increased risk for unintentional injuries compared with non-smokers. Although this study is a cross-sectional study that does not distinguish men and women, since it is a study of more than 200,000 Koreans, it is in continuous nature with our study in terms of representation of Korean adults and shows similar results.

There was another study which evaluated the association between cigarette smoking and external causes of death using relative risk for death of 25 years later, which means long-term effect. Current smoker had an increased rate for external causes of death (men RR=1.13, 95%CI=1.04-1.22; women RR=1.24, 95%CI=1.01-1.52), poisoning (men RR=1.96, 95%CI=1.25-3.06; women RR=2.14, 95%CI=0.93-4.92), intentional self-harm (men RR=1.69, 95%CI=1.27-2.24; women RR=2.19, 95%CI=1.03-4.66). But not in homicide (men RR=1.40, 95%CI=0.89-2.21; women RR=1.20, 95%CI=0.36-4.07). Current smoking was also associated with injury undetermined in men (RR=1.25, 95%CI=1.03-1.52). But in women, the RR was not estimated due to small sample.

5. *Possible explanations*

Several plausible explanations may explain the impact of smoking status on external causes of death.

Direct toxicity

First, direct toxicity of carbon monoxide or nicotine from cigarette smoking may increase the risk of external causes of death.[18] The elevated levels of carboxyhemoglobin have been associated with reduced night vision, lower scores on performance and vision test, increases in driving judgement errors, and reduced driving performance which could explain the results of transport accident death in men.[18,50-52] Decreased functions such as muscle strength, swallowing, agility, and waking balance could increase the risk of external causes of death.[15,18,19,53] This could explain the results of suffocation death in men. Because decreased swallowing functions could increase the risk of aspiration pneumonia or asphyxia, which could be seen as both short-term and long-term effect of smoking, as we could see the results in time-dependent Cox regression in men.

Distraction

Second, distraction may be another reason. The act of lighting and holding a cigarette, driving with one hand off the wheel, finding a lighter and shaking cigarette ash causes temporary losses of attention, especially in transport accident.[18,20,53,54] This could explain the short-term effect of smoking on transport accident, which was statistically significant in time-dependent Cox regression results in men.

Personality and behavioral characteristics

Third, smokers tend to behave more dangerously than non-smokers through risk-taking behaviors.[19,53] Smokers have lower rates of use of driving safety belts, more traffic violations, and more drunk driving instances than non-smokers.[19,53,55-57] Several studies have suggested that

smokers are more likely than nonsmokers to be nervous, anxious and emotional and to display hysterical personality characteristics or obsessional traits or to act out hostility.[18,58-60] Smoking might be a marker for a risk-taking behavior that would persist even if a person quit smoking.[18] In previous study, generally, past smokers appear to have a lower risk of injury than current smokers which suggests that smoking itself is related to injury risk.[18] But in our study, especially in women, some hazard ratios were even higher in past smoking group than current smoking group in women, which suggests that not only smoking itself but also personality could be related to injury risk in women.

Associated medical conditions

Fourth, smoking-related diseases, such as cardiovascular diseases and cancer, could affect the risk of external causes of death, such as transport accident.[18,61] Furthermore, cigarette smoking has adverse effects on wound healing that can delay or prevent recovery from injury.[20] These kinds of smoking-associated medical conditions could explain the long-term effect of smoking, which could affect event after quitting smoking. Hence, the cumulative effect could have a greater impact on past smokers. As the result, some hazard ratios were even higher in past smoking group than current smoking group in women. The past smokers may have stopped smoking only because their physical condition deteriorated. Taken together with the above ‘personality’ factor, a person with risk-taking behavior could become a past smoking group when the medical situation worsens in women. In addition, the medical effects of smoking could be biologically different between men and women.

Residual Confounding

Lastly, residual confounding, especially types of jobs, could be another possible reason for an association between smoking and external causes of death, which could not be estimated in this study, unfortunately. In the case that types of job were associated with external causes of death, smoking could be a surrogate marker of types of job. Also, education or marital status play a role in explaining a smoking-injury association,[18] which could not be controlled for in this study. Confounding factors such as depression could be also a reason for an association between smoking and intentional self-harm. However, there are many studies showing that the association is maintained even after adjusting depression.[22-24,62] One previous study suggested that current smokers have increased risks of suicidal ideation above and beyond the risk for never and former smokers regardless of age, gender, history of depressive disorder and/or anxiety symptoms, and alcohol abuse/dependence.[62]

6. *Strengths and limitations*

Strengths of this study include a longitudinal study design with 14 years of follow-up, and a large nationwide study including 493,031 adults aged 40 to 79 years. In addition, external causes of deaths were verified by official medical records through Cause of death statistics in Korea.

However, several limitations need to be addressed. First, this is an observational study, so we should interpret carefully regarding causality. Second, although we controlled many confounders, residual confounding could remain such as types of job, which could affect the events of external causes of deaths related to job environment. Mental health, socioeconomic status and geographic factors also could be residual confounding. Third, the smoking intensity and smoking duration were not used accurately in this study. Hence, accumulation effect of smoking could remain as residual

confounder. There were questionnaires in screening about the smoking intensity and smoking duration, but the smoking intensity changed every day and the percentage of missing was about to 30% at baseline. Smoking duration in the past was not accurate, which was coded as categorial variable as ‘less than 5 years’, ‘5-9 years’, ’10-19 years’, ’20-29 years’, and ‘more than 30 years’. So, it could not be used in main results. However, in sensitivity analysis, baseline smoking intensity was used, and we could find dose-response relationships between baseline smoking intensity and some subgroups of unintentional injury death. Fourth, although we used ‘last observation carried forward’ method for missing data of smoking status, the exact smoking status could not be calculated in some participants. Interval censoring could be generated. Fifth, the current study findings cannot be generalized to all Korean adults, because study participants were the 2002 and 2003 health screening participants, who were aged between 40 and 79 in 2002. Even though some people were subject to National Health Insurance general health screening program, they did not participate program if they were busy with their lives or did not know the information. And most of them were people with low-income level as shown in Table 1. That means that the results were likely to have been underestimated because the study only dealt with people with high income level.

V. CONCLUSION

Cigarette smoking is associated with increased risks of diseases and deaths including external causes of death. Despite its importance, only a few studies have evaluated the effect of cigarette smoking on unintentional injury death in Korea. In the current study, we found a significant association between cigarette smoking and external causes of death, unintentional injury death, and intentional self-harm both in long-term and short-term in Korean men and women.

We identified 493,031 persons aged 40 to 79 years, who were health screening participants in 2002 and 2003. Risk was estimated using a Cox proportional hazards model with and without time-dependent covariates. In both sex, current smoker has higher risk of external causes of death, unintentional injury death and intentional self-harm than never smoker. When using time-dependent Cox regression, the result was similar. In subgroup of unintentional injury death, current smoker has higher risk of suffocation death in men, and higher risk of fall and other unintentional injury death in women than never smoker. In time-dependent Cox regression, current smoking at event time has higher risk of transport accident, suffocation, and other unintentional injury death in men, and higher risk of other unintentional injury death in women than never smoking. Past smoking at event time has higher risk of suffocation death in men and, and other unintentional injury death in women than never smoking.

Our discovery of long-term and short-term effect of cigarette smoking on unintentional injury death and other external causes of death holds important clinical significance. According to the 2020 Industrial Accident Death Statistics released by the Ministry of Employment and Labor, the number of industrial accident deaths in 2020 was 882, an increase of 27 compared to 2019, followed by ‘fall’ (328), ‘crush’ (98), and ‘hit’ (72).[63] The number of deaths from construction was 458 (51.9% of the

total), and the manufacturing industry was 201 (22.8% of the total).[63] Of the 882 accident deaths, 72.4% (639) were aged 50 or older, 39.3% (347) were aged 60 or older.[63] As we could see above, the majority of industrial accident deaths are blue-collar men over the age of 50, who are more likely to smoke. To reduce industrial accident deaths, it is necessary to implement a policy to reduce their smoking rates by continuously analyzing the effects of smoking on their accidents. Because the risk of unintentional injury death could be reduced after smoking cessation, it is also necessary to implement a policy to prevent smoking while doing dangerous works, to reduce unintentional injury death including industrial accidents. For women, due to small scale of events, more long-term follow-up and larger scale studies would be necessary for more accurate association between smoking and external causes of death.

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APPENDIX

Appendix Table 1-1. Associations between baseline smoking status and external causes of death using age as time scale in men

Death	Baseline smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	HR (95% CI)	
					unadjusted	adjusted*
External causes of death	Never smoker	1,377,462	1,585	115.1	ref	ref
	Past smoker	513,160	474	92.4	0.96 (0.87-1.06)	0.92 (0.83-1.02)
	Current smoker	1,371,152	1,764	128.7	1.48 (1.38-1.58)	1.26 (1.18-1.36)
Unintentional injury death	Never smoker	1,377,462	996	72.3	ref	ref
	Past smoker	513,160	311	60.6	1.01 (0.89-1.15)	0.97 (0.85-1.10)
	Current smoker	1,371,152	1,004	73.2	1.35 (1.24-1.47)	1.15 (1.05-1.26)
Intentional self-harm death	Never smoker	1,377,462	575	41.7	ref	ref
	Past smoker	513,160	156	30.4	0.86 (0.72-1.03)	0.83 (0.69-0.99)
	Current smoker	1,371,152	744	54.3	1.68 (1.51-1.87)	1.46 (1.30-1.64)
Homicide	Never smoker	1,377,462	14	1.0	ref	ref
	Past smoker	513,160	7	1.4	1.47 (0.59-3.65)	1.32 (0.50-3.45)
	Current smoker	1,371,152	16	1.2	1.32 (0.64-2.70)	0.88 (0.39-1.98)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree, and stratified for covariates which do not satisfy proportional hazard assumption.
HR = Hazard ratio; CI = confidence interval.

Appendix Table 1-2. Associations between baseline smoking status and external causes of death using age as time scale in women

Death	Baseline smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	HR (95% CI)	
					unadjusted	adjusted*
External causes of death	Never smoker	2,708,203	1,250	46.2	ref	ref
	Past smoker	26,448	23	87.0	1.61 (1.07-2.43)	1.62 (1.07-2.46)
	Current smoker	76,311	93	121.9	1.74 (1.41-2.15)	1.79 (1.44-2.22)
Unintentional injury death	Never smoker	2,708,203	755	27.9	ref	ref
	Past smoker	26,448	14	52.9	1.57 (0.93-2.67)	1.66 (0.97-2.81)
	Current smoker	76,311	62	81.2	1.83 (1.41-2.38)	1.86 (1.43-2.43)
Intentional self-harm death	Never smoker	2,708,203	468	17.3	ref	ref
	Past smoker	26,448	9	34.0	1.75 (0.91-3.38)	1.63 (0.83-3.19)
	Current smoker	76,311	28	36.7	1.50 (1.02-2.21)	1.56 (1.05-2.31)
Homicide	Never smoker	2,708,203	27	1.0	Ref	ref
	Past smoker	26,448	0	0.0	0	0
	Current smoker	76,311	3	3.9	3.13 (0.93-10.61)	2.87 (0.91-9.07)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree, and stratified for covariates which do not satisfy proportional hazard assumption.
HR = Hazard ratio; CI = confidence interval.

Appendix Table 2-1. Associations between baseline smoking status and subgroup of unintentional injury death using age as time scale in men

Death	Baseline smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	HR (95% CI)	
					unadjusted	adjusted*
Transport accident	Never smoker	1,377,462	479	34.8	ref	ref
	Past smoker	513,160	142	27.7	0.95 (0.79-1.15)	0.91 (0.75-1.10)
	Current smoker	1,371,152	461	33.6	1.26 (1.11-1.43)	1.06 (0.93-1.21)
Fall	Never smoker	1,377,462	156	11.3	ref	Ref
	Past smoker	513,160	57	11.1	1.18 (0.87-1.60)	1.14 (0.84-1.55)
	Current smoker	1,371,152	153	11.2	1.31 (1.05-1.63)	1.18 (0.93-1.50)
Drowning	Never smoker	1,377,462	35	2.5	ref	ref
	Past smoker	513,160	9	1.8	0.81 (0.39-1.69)	0.71 (0.34-1.46)
	Current smoker	1,371,152	50	3.6	1.82 (1.18-2.80)	1.38 (0.87-2.18)
Suffocation	Never smoker	1,377,462	19	1.4	ref	ref
	Past smoker	513,160	7	1.4	1.23 (0.52-2.93)	1.25 (0.52-3.01)
	Current smoker	1,371,152	33	2.4	2.48 (1.43-4.30)	2.38 (1.36-4.15)
Fire	Never smoker	1,377,462	9	0.7	Ref	ref
	Past smoker	513,160	3	0.6	1.07 (0.29-3.89)	1.02 (0.30-3.50)
	Current smoker	1,371,152	13	0.9	1.89 (0.83-4.31)	1.65 (0.74-3.69)
Poisoning	Never smoker	1,377,462	14	1.0	ref	ref
	Past smoker	513,160	2	0.4	N/A	N/A
	Current smoker	1,371,152	13	0.9	1.22 (0.57-2.64)	1.04 (0.44-2.46)
Other unintentional injury	Never smoker	1,377,462	284	20.6	ref	Ref
	Past smoker	513,160	91	17.7	1.05 (0.83-1.33)	1.01 (0.79-1.28)
	Current smoker	1,371,152	281	20.5	1.36 (1.16-1.60)	1.19 (1.001-1.42)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree, and stratified for covariates which do not satisfy proportional hazard assumption.
If number of events is less than three, HR (95% CI) is presented as N/A.
HR = Hazard ratio; CI = confidence interval; N/A = not available.

Appendix Table 2-2. Associations between baseline smoking status and subgroup of unintentional injury death using age as time scale in women

Death	Baseline smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	HR (95% CI)	
					unadjusted	adjusted*
Transport accident	Never smoker	2,708,203	343	12.7	ref	ref
	Past smoker	26,448	5	18.9	1.34 (0.55-3.25)	1.59 (0.65-3.85)
	Current smoker	76,311	15	19.7	1.09 (0.65-1.84)	1.22 (0.73-2.02)
Fall	Never smoker	2,708,203	85	3.1	ref	ref
	Past smoker	26,448	1	3.8	N/A	N/A
	Current smoker	76,311	9	11.8	2.25 (1.12-4.50)	2.48 (1.24-4.97)
Drowning	Never smoker	2,708,203	20	0.7	ref	Ref
	Past smoker	26,448	1	3.8	N/A	N/A
	Current smoker	76,311	3	3.9	3.64 (1.06-12.51)	3.24 (0.79-13.26)
Suffocation	Never smoker	2,708,203	29	1.1	ref	ref
	Past smoker	26,448	1	3.8	N/A	N/A
	Current smoker	76,311	1	1.3	N/A	N/A
Fire	Never smoker	2,708,203	15	0.6	ref	ref
	Past smoker	26,448	0	0.0	0	0
	Current smoker	76,311	3	3.9	4.63 (1.34-16.07)	3.28 (0.84-12.85)
Poisoning	Never smoker	2,708,203	11	0.4	ref	Ref
	Past smoker	26,448	0	0.0	0	0
	Current smoker	76,311	0	0.0	0	0
Other unintentional injury	Never smoker	2,708,203	252	9.3	ref	Ref
	Past smoker	26,448	6	22.7	1.86 (0.83-4.19)	1.80 (0.79-4.13)
	Current smoker	76,311	31	40.6	2.46 (1.68-3.59)	2.38 (1.61-3.50)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree, and stratified for covariates which do not satisfy proportional hazard assumption.
If number of events is less than three, HR (95% CI) is presented as N/A.
HR = Hazard ratio; CI = confidence interval; N/A = not available.

Appendix Table 3-1. Associations between baseline smoking status (by two categories) and external causes of death in men

Death	Baseline smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	unadjusted	adjusted*
					HR (95% CI)	HR (95% CI)
External causes of death	Non smoker	1,890,622	2,059	108.9	ref	ref
	Current smoker	1,371,152	1,764	128.7	1.18 (1.11-1.26)	1.28 (1.19-1.36)
Unintentional injury death	Non smoker	1,890,622	1,307	69.1	ref	Ref
	Current smoker	1,371,152	1,004	73.2	1.06 (0.972-1.15)	1.15 (1.06-1.26)
Intentional self-harm death	Non smoker	1,890,622	731	38.7	ref	ref
	Current smoker	1,371,152	744	54.3	1.40 (1.26-1.55)	1.52 (1.36-1.68)
Homicide	Non smoker	1,890,622	21	1.1	ref	Ref
	Current smoker	1,371,152	16	1.2	1.05 (0.55-2.01)	0.81 (0.39-1.66)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree, and stratified for covariates which do not satisfy proportional hazard assumption.
HR = Hazard ratio; CI = confidence interval.

Appendix Table 3-2. Associations between baseline smoking status (by two categories) and external causes of death in women

Death	Baseline smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	unadjusted	adjusted*
					HR (95% CI)	HR (95% CI)
External causes of death	Non smoker	2,734,651	1,273	46.6	ref	ref
	Current smoker	76,311	93	121.9	2.51 (2.03-3.10)	1.83 (1.48-2.27)
Unintentional injury death	Non smoker	2,734,651	769	28.1	ref	Ref
	Current smoker	76,311	62	81.2	2.76 (2.13-3.58)	1.93 (1.48-2.52)
Intentional self-harm death	Non smoker	2,734,651	477	17.4	ref	ref
	Current smoker	76,311	28	36.7	2.01 (1.37-2.94)	1.59 (1.07-2.35)
Homicide	Non smoker	2,734,651	27	1.0	ref	ref
	Current smoker	76,311	3	3.9	3.79 (1.15-12.50)	2.94 (0.93-9.32)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree, and stratified for covariates which do not satisfy proportional hazard assumption.
HR = Hazard ratio; CI = confidence interval.

Appendix Table 4-1. Associations between baseline smoking status (by two categories) and subgroup of unintentional injury death in men

Death	Baseline smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	unadjusted	adjusted*
					HR (95% CI)	HR (95% CI)
Transport accident	Non smoker	1,890,622	621	32.8	ref	ref
	Current smoker	1,371,152	461	33.6	1.02 (0.90-1.15)	1.07 (0.95-1.22)
Fall	Non smoker	1,890,622	213	11.3	ref	Ref
	Current smoker	1,371,152	153	11.2	0.99 (0.80-1.21)	1.13 (0.90-1.41)
Drowning	Non smoker	1,890,622	44	2.3	ref	ref
	Current smoker	1,371,152	50	3.6	1.56 (1.04-2.34)	1.48 (0.96-2.29)
Suffocation	Non smoker	1,890,622	26	1.4	ref	Ref
	Current smoker	1,371,152	33	2.4	1.74 (1.04-2.91)	2.28 (1.37-3.78)
Fire	Non smoker	1,890,622	12	0.6	ref	ref
	Current smoker	1,371,152	13	0.9	1.48 (0.68-3.25)	1.62 (0.73-3.61)
Poisoning	Non smoker	1,890,622	16	0.8	ref	Ref
	Current smoker	1,371,152	13	0.9	1.12 (0.54-2.32)	1.22 (0.55-2.74)
Other unintentional injury	Non smoker	1,890,622	375	19.8	ref	ref
	Current smoker	1,371,152	281	20.5	1.03 (0.88-1.20)	1.17 (1.000-1.38)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree, and stratified for covariates which do not satisfy proportional hazard assumption.
HR = Hazard ratio; CI = confidence interval.

Appendix Table 4-2. Associations between baseline smoking status (by two categories) and subgroup of unintentional injury death in women

Death	Smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	unadjusted	adjusted*
					HR (95% CI)	HR (95% CI)
Transport accident	Non smoker	2,734,651	348	12.7	ref	ref
	Current smoker	76,311	15	19.7	1.47 (0.88-2.47)	1.25 (0.75-2.07)
Fall	Non smoker	2,734,651	86	3.1	ref	Ref
	Current smoker	76,311	9	11.8	3.58 (1.80-7.12)	2.59 (1.29-5.19)
Drowning	Non smoker	2,734,651	21	0.8	ref	ref
	Current smoker	76,311	3	3.9	4.88 (1.46-16.35)	3.45 (0.84-14.15)
Suffocation	Non smoker	2,734,651	30	1.1	ref	Ref
	Current smoker	76,311	1	1.3	N/A	N/A
Fire	Non smoker	2,734,651	15	0.5	ref	ref
	Current smoker	76,311	3	3.9	6.82 (1.97-23.54)	3.41 (0.87-13.42)
Poisoning	Non smoker	2,734,651	11	0.4	ref	Ref
	Current smoker	76,311	0	0.0	0	0
Other unintentional injury	Non smoker	2,734,651	258	9.4	ref	Ref
	Current smoker	76,311	31	40.6	4.11 (2.83-5.97)	2.50 (1.70-3.68)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree, and stratified for covariates which do not satisfy proportional hazard assumption.
If number of events is less than three, HR (95% CI) is presented as N/A.
HR = Hazard ratio; CI = confidence interval; N/A = not available.

Appendix table 5. Characteristics of study participants by smoking status at event time

Variable	Men (n=266,239)				Women (n=226,792)			
	Never smoking (n=128,414)	Past smoking (n=64,984)	Current smoking (n=72,841)	p-value	Never smoking (n=217,417)	Past smoking (n=5,143)	Current smoking (n=4,232)	p-value
Age (y)								
40-49	515 (0.4)	113 (0.2)	801 (1.1)	<0.0001	522 (0.2)	8 (0.2)	22 (0.5)	<0.0001
50-59	39,403 (30.68)	26,690 (41.1)	33,693 (46.3)		68,193 (31.4)	1,610 (31.3)	1,189 (28.1)	
60-69	43,723 (34.1)	23,136 (35.6)	24,044 (33.0)		71,970 (33.1)	1,584 (30.8)	1,089 (25.7)	
70-79	32,295 (25.2)	12,010 (18.5)	11,290 (15.5)		53,497 (24.6)	1,185 (23.0)	1,068 (25.2)	
80-89	11,875 (9.3)	2,936 (4.5)	2,914 (4.0)		21,983 (10.1)	712 (13.8)	818 (19.3)	
≥90	603 (0.5)	99 (0.2)	99 (0.1)		1,252 (0.6)	44 (0.9)	46 (1.1)	
Alcohol drinking status								
Never	19,169 (14.9)	4,767 (7.3)	7,755 (10.7)	<0.0001	57,722 (26.6)	1,080 (21.0)	1,560 (36.9)	<0.0001
2-3 times/month	6,787 (5.3)	3,567 (5.5)	4,547 (6.2)		6,284 (2.9)	303 (5.9)	342 (8.1)	
1-2 times/week	68,997 (53.7)	33,637 (51.8)	29,678 (40.7)		146,194 (67.2)	3,241 (63.0)	1,651 (39.0)	
3-4times/week	22,455 (17.5)	15,508 (23.9)	19,138 (26.3)		5,122 (2.4)	362 (7.0)	437 (10.3)	
Every day	8,447 (6.6)	5,716 (8.8)	9,529 (13.1)		1,076 (0.5)	104 (2.0)	180 (4.3)	
N/A	2,559 (2.0)	1,789 (2.8)	2,194 (3.0)		1,019 (0.5)	53 (1.0)	62 (1.5)	
Hypertension								
No	97,795 (76.2)	51,524 (79.3)	56,330 (77.3)	<0.0001	171,965 (79.1)	4,244 (82.5)	3,267 (77.2)	<0.0001
Yes	30,594 (23.8)	13,443 (20.7)	16,496 (22.7)		45,397 (20.9)	895 (17.4)	963 (22.8)	
N/A	25 (0.0)	17 (0.0)	15 (0.0)		55 (0.0)	4 (0.1)	2 (0.1)	
Diabetes Mellitus								
No	112,119 (87.3)	55,404 (85.3)	61,717 (84.7)	<0.0001	197,592 (90.9)	4,553 (88.5)	3,695 (87.3)	<0.0001
Yes	16,212 (12.6)	9,566 (14.7)	11,093 (15.2)		19,717 (9.1)	587 (11.4)	531 (12.6)	
N/A	83 (0.1)	14 (0.0)	31 (0.0)		108 (0.1)	3 (0.1)	6 (0.1)	
CCI score (1 yr before event)								
0	40,650 (31.7)	20,776 (32.0)	26,583 (36.5)	<0.0001	61,749 (28.4)	1,199 (23.3)	910 (21.5)	<0.0001
1	30,039 (23.4)	15,578 (24.0)	15,985 (22.0)		54,411 (25.0)	1,160 (22.6)	949 (22.4)	
≥2	57,725 (45.0)	28,630 (44.1)	30,273 (41.6)		101,257 (46.6)	2,784 (54.1)	2,373 (56.1)	
Income level (decile & medical care)								
0 (lowest, medical care)	2,248 (1.8)	742 (1.1)	2,228 (3.1)	<0.0001	5,868 (2.7)	284 (5.5)	496 (11.7)	<0.0001
1-3	22,878 (17.8)	11,891 (18.3)	15,346 (21.1)		49,677 (22.9)	1,467 (28.5)	1,185 (28.0)	
4-6	26,724 (20.8)	14,855 (22.9)	18,284 (25.1)		47,669 (21.9)	1,271 (24.7)	1,052 (24.9)	
7-10	76,564 (59.6)	37,496 (57.7)	36,983 (50.8)		114,203 (52.5)	2,121 (41.2)	1,499 (35.4)	

Disability degree								
Non-disabled	113,360 (88.3)	57,966 (89.2)	65,487 (89.9)	<0.0001	198,058 (91.1)	4,654 (90.5)	3,836 (90.6)	0.4591
Severe (class 1-2)	2,404 (1.9)	847 (1.3)	972 (1.3)		2,501 (1.2)	60 (1.2)	54 (1.3)	
Mild (class 3-6)	12,650 (9.9)	6,171 (9.5)	6,382 (8.7)		16,858 (7.8)	429 (8.3)	342 (8.1)	

Values are presented as number (%).
CCI = Charlson comorbidity index.

Appendix Table 6-1. Associations between smoking status (by two categories) and external causes of death using time-dependent Cox regression in men

Death	Smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	HR (95% CI)	
					unadjusted	adjusted*
External causes of death	Non smoking	2,129,163	2,305	108.3	ref	ref
	Smoking	1,132,610	1,518	134.0	1.25 (1.18-1.34)	1.40 (1.31-1.50)
Unintentional injury death	Non smoking	2,129,163	1,461	68.6	ref	Ref
	Smoking	1,132,610	850	75.0	1.10 (1.01-1.20)	1.25 (1.14-1.36)
Intentional self-harm death	Non smoking	2,129,163	823	38.7	ref	ref
	Smoking	1,132,610	652	57.6	1.52 (1.37-1.69)	1.69 (1.52-1.87)
Homicide	Non smoking	2,129,163	21	1.0	ref	Ref
	Smoking	1,132,610	16	1.4	1.37 (0.70-2.68)	1.11 (0.54-2.27)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree.
HR = Hazard ratio; CI = confidence interval.

Appendix Table 6-2. Associations between smoking status (by two categories) and external causes of death using time-dependent Cox regression in women

Death	Smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	HR (95% CI)	
					unadjusted	adjusted*
External causes of death	Non smoking	2,747,449	1,300	47.3	ref	ref
	Smoking	63,513	66	103.9	2.21 (1.73-2.83)	1.61 (1.25-2.07)
Unintentional injury death	Non smoking	2,747,449	790	28.8	ref	Ref
	Smoking	63,513	41	64.6	2.25 (1.64-3.08)	1.57 (1.14-2.16)
Intentional self-harm death	Non smoking	2,747,449	482	17.5	ref	ref
	Smoking	63,513	23	36.2	2.09 (1.37-3.17)	1.65 (1.07-2.53)
Homicide	Non smoking	2,747,449	28	1.0	ref	ref
	Smoking	63,513	2	3.1	N/A	N/A

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree.
If number of events is less than three, HR (95% CI) is presented as N/A.
HR = Hazard ratio; CI = confidence interval; N/A = not available.

Appendix Table 7-1. Associations between smoking status (by two categories) and subgroup of unintentional injury death using time-dependent Cox regression in men

Death	Smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	HR (95% CI)	
					unadjusted	adjusted*
Transport accident	Non smoking	2,129,163	683	32.1	ref	ref
	Smoking	1,132,610	399	35.2	1.09 (0.96-1.23)	1.18 (1.04-1.34)
Fall	Non smoking	2,129,163	240	11.3	ref	Ref
	Smoking	1,132,610	126	11.1	0.99 (0.80-1.23)	1.16 (0.93-1.45)
Drowning	Non smoking	2,129,163	54	2.5	ref	ref
	Smoking	1,132,610	40	3.5	1.40 (0.93-2.10)	1.37 (0.89-2.12)
Suffocation	Non smoking	2,129,163	36	1.7	ref	Ref
	Smoking	1,132,610	23	2.0	1.26 (0.75-2.12)	1.60 (0.97-2.66)
Fire	Non smoking	2,129,163	13	0.6	ref	ref
	Smoking	1,132,610	12	1.1	1.72 (0.78-3.76)	1.93 (0.88-4.22)
Poisoning	Non smoking	2,129,163	14	0.7	ref	Ref
	Smoking	1,132,610	15	1.3	1.91 (0.91-4.02)	2.25 (1.02-4.94)
Other unintentional injury	Non smoking	2,129,163	421	19.8	ref	ref
	Smoking	1,132,610	235	20.7	1.09 (0.93-1.28)	1.31 (1.11-1.54)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree.
HR = Hazard ratio; CI = confidence interval.

Appendix Table 7-2. Associations between smoking status (by two categories) and subgroup of unintentional injury death using time-dependent Cox regression in women

Death	Smoking status	Person-years	Number of events	Rate of events (per 100,000 person-years)	HR (95% CI)	
					unadjusted	adjusted*
Transport accident	Non smoking	2,747,449	350	12.7	ref	ref
	Smoking	63,513	13	20.5	1.57 (0.91-2.73)	1.33 (0.77-2.30)
Fall	Non smoking	2,747,449	89	3.2	ref	Ref
	Smoking	63,513	6	9.4	2.90 (1.27-6.60)	2.08 (0.90-4.79)
Drowning	Non smoking	2,747,449	22	0.8	ref	ref
	Smoking	63,513	2	3.1	N/A	N/A
Suffocation	Non smoking	2,747,449	31	1.1	ref	ref
	Smoking	63,513	0	0.0	0	0
Fire	Non smoking	2,747,449	16	0.6	ref	ref
	Smoking	63,513	2	3.1	N/A	N/A
Poisoning	Non smoking	2,747,449	11	0.4	ref	ref
	Smoking	63,513	0	0.0	0	0
Other unintentional injury	Non smoking	2,747,449	271	9.9	ref	ref
	Smoking	63,513	18	28.3	2.98 (1.85-4.81)	1.82 (1.12-2.96)

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree.
If number of events is less than three, HR (95% CI) is presented as N/A.
HR = Hazard ratio; CI = confidence interval; N/A = not available.

Appendix Table 8. Distribution of number of screenings in each participant according to year

Number of screening	Year														Total	
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015		
1st	280,792	212,239													493,031	100%
2nd		85,345	137,606	107,925	48,465	30,309	18,405	14,272	7,702	6,804	3,742	2,763	1,806	1,690	466,834	95%
3rd			66,914	32,973	94,608	86,464	45,550	40,555	21,960	19,336	10,500	8,444	5,367	5,155	437,826	89%
4th				55,049	28,306	18,318	77,435	73,541	43,775	41,341	22,520	18,923	11,567	11,348	402,123	82%
5th					47,336	24,299	17,004	17,442	66,095	60,593	39,892	38,056	22,687	22,346	355,750	72%
6th						40,872	22,863	15,364	14,352	15,859	54,166	47,159	38,132	41,275	290,042	59%
7th							36,266	20,697	14,380	12,740	11,995	12,686	44,856	42,725	196,345	40%
8th								32,203	19,032	13,466	11,203	9,960	10,730	17,038	113,632	23%
9th									28,870	17,584	12,087	10,019	9,657	9,596	87,813	18%
10th										26,006	15,830	11,027	9,727	9,080	71,670	15%
11th											23,274	14,061	10,724	9,233	57,292	12%
12th												20,510	13,318	10,059	43,887	9%
13th													18,317	12,376	30,693	6%
14th														16,368	16,368	3%
Total	280,792	297,584	204,520	195,947	218,715	200,262	217,523	214,074	216,166	213,729	205,209	193,608	196,888	208,289	3,063,306	

Appendix Table 9. Distribution of smoking intensity at baseline screening

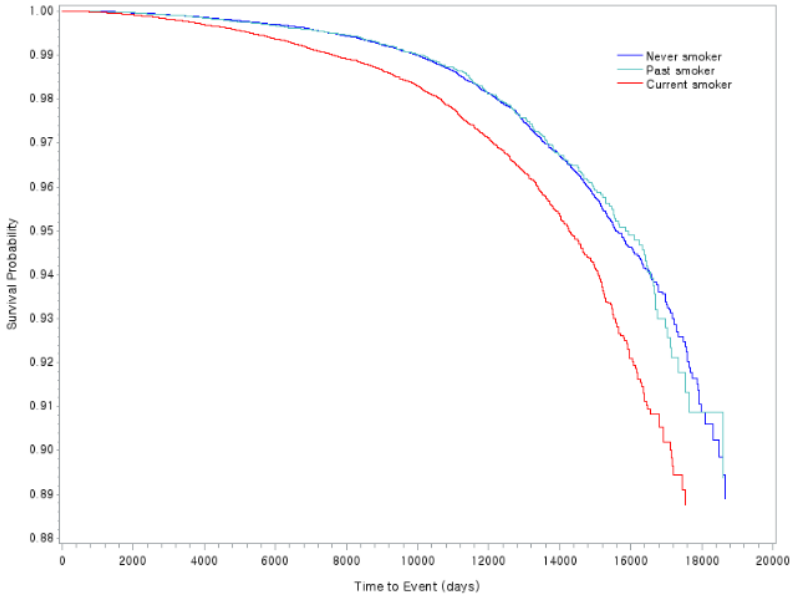
Smoking intensity at baseline screening	Men		Women	
< 1/2 pack/day	25,705	17%	4,154	48%
1/2 - 1 pack/day	60,901	40%	1,877	22%
1 - 2pack/day	23,910	16%	420	5%
≥ 2pack/day	1,627	1%	25	0%
Sum of response	112,143	73%	6,476	75%
Unknown	41,519	27%	2,170	25%
Total	153,662	100%	8,646	100%

Appendix Table 10. Associations between baseline smoking intensity and subgroup of unintentional injury death using time-dependent Cox regression in men and women

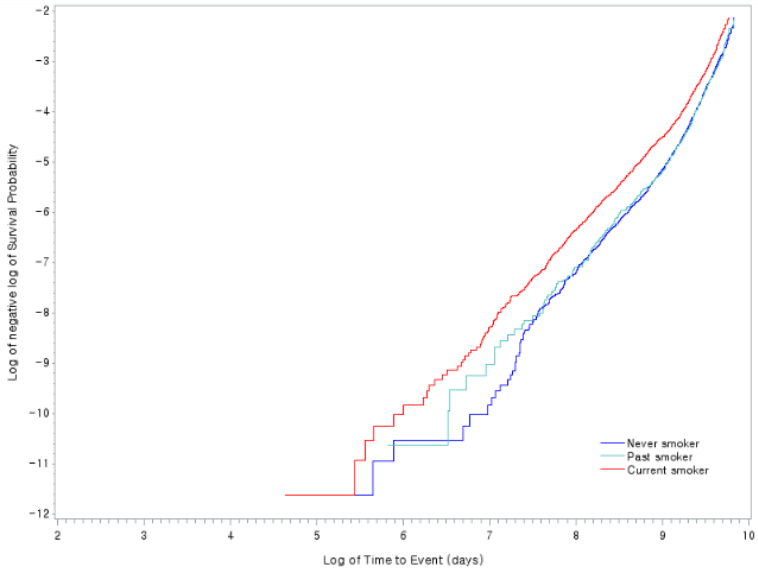
Gender	Death	Baseline smoking intensity	Person-years	Number of events	Rate of events (per 100,000 person-years)	HR (95% CI)	P for trend (excluding unknown)
Men							
	Transport accident	Never smoking	1667278	555	33.3	ref	0.0241
		Past smoking	461887	128	27.7	0.95 (0.77-1.15)	
		Current smoking (< 1 pack/day)	746930	286	38.3	1.24 (1.07-1.43)	
		Current smoking (≥ 1pack/day)	245875	76	30.9	1.08 (0.84-1.37)	
		Current smoking (unknown)	139807	37	26.5	0.95 (0.68-1.33)	
	Suffocation	Never smoking	1667278	24	1.4	ref	0.0007
		Past smoking	461887	12	2.6	2.15 (1.07-4.36)	
		Current smoking (< 1 pack/day)	746930	16	2.1	2.08 (1.11-3.89)	
		Current smoking (≥ 1pack/day)	245875	7	2.8	3.43 (1.52-7.76)	
		Current smoking (unknown)	139807	0	0.0	N/A	
	Other unintentional injury	Never smoking	1667278	324	19.4	ref	0.0032
		Past smoking	461887	97	21.0	1.17 (0.93-1.47)	
		Current smoking (< 1 pack/day)	746930	151	20.2	1.28 (1.05-1.56)	
		Current smoking (≥ 1pack/day)	245875	49	19.9	1.45 (1.07-1.97)	
		Current smoking (unknown)	139807	35	25.0	1.59 (1.12-2.26)	
Women							
	Fall	Never smoking	2713693	86	3.2	ref	0.0122
		Past smoking	33757	3	8.9	2.28 (0.71-7.29)	
		Current smoking (< 1 pack/day)	47716	6	12.6	2.75 (1.18-6.37)	
		Current smoking (≥ 1pack/day)	3865	0	0.0	N/A	
		Current smoking (unknown)	11931	0	0.0	N/A	
	Other unintentional injury	Never smoking	2713693	256	9.4	ref	<0.0001
		Past smoking	33757	15	44.4	2.88 (1.69-4.91)	
		Current smoking (< 1 pack/day)	47716	15	31.4	2.10 (1.23-3.59)	
		Current smoking (≥ 1pack/day)	3865	2	51.7	3.32 (0.91-12.14)	
		Current smoking (unknown)	11931	1	8.4	0.61 (0.09-4.35)	

* Adjusted for age, alcohol drinking status, hypertension, diabetes mellitus, Charlson comorbidity index, income level, disability degree.
HR = Hazard ratio; CI = confidence interval; N/A = not available.

A) (time to Event 0 means the age of 40)



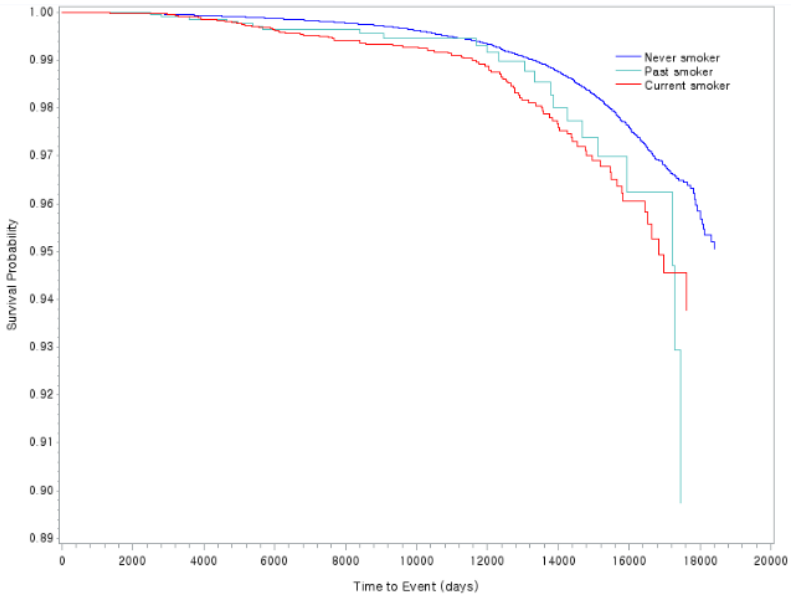
B) with zph 0.7607(past smoker) and <.0001(current smoker)



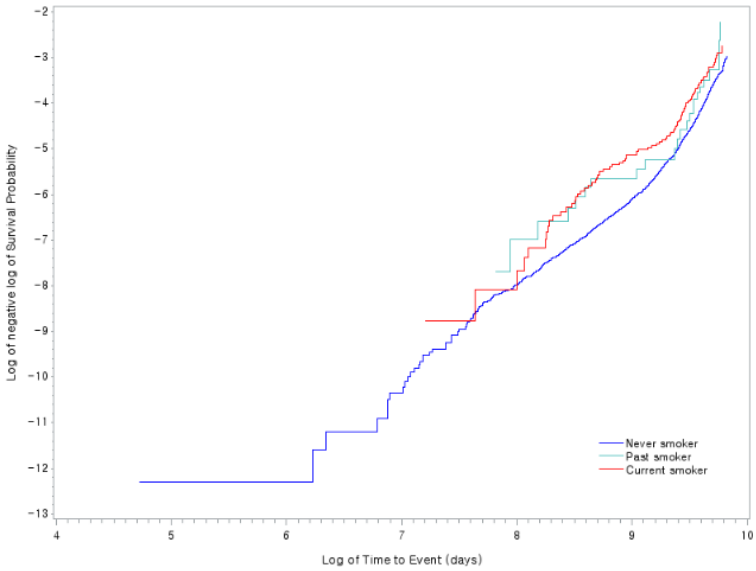
Appendix Figure 1. Survival plot (A) and log-log survival plot (B)

stratified by baseline smoking status for external causes of death using age as time scale in men

A) (time to Event 0 means the age of 40)



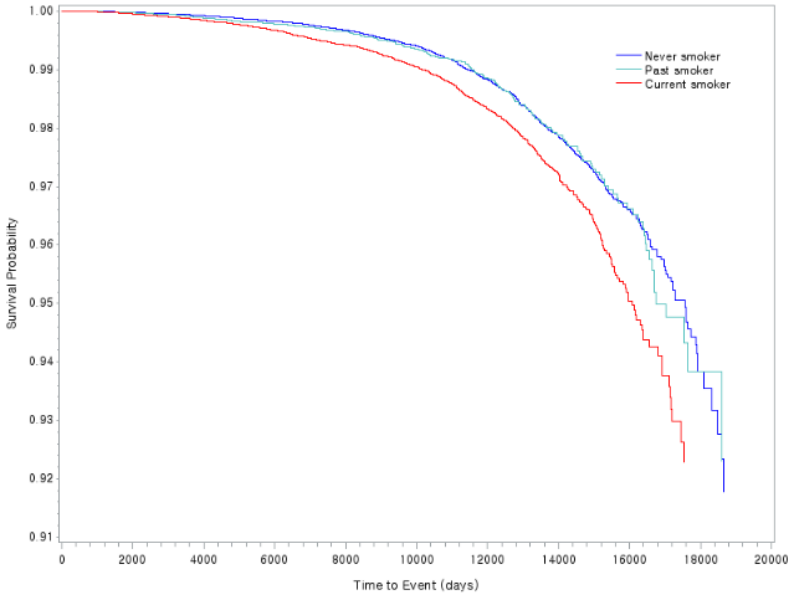
B) with zph 0.9447(past smoker) and 0.0648(current smoker)



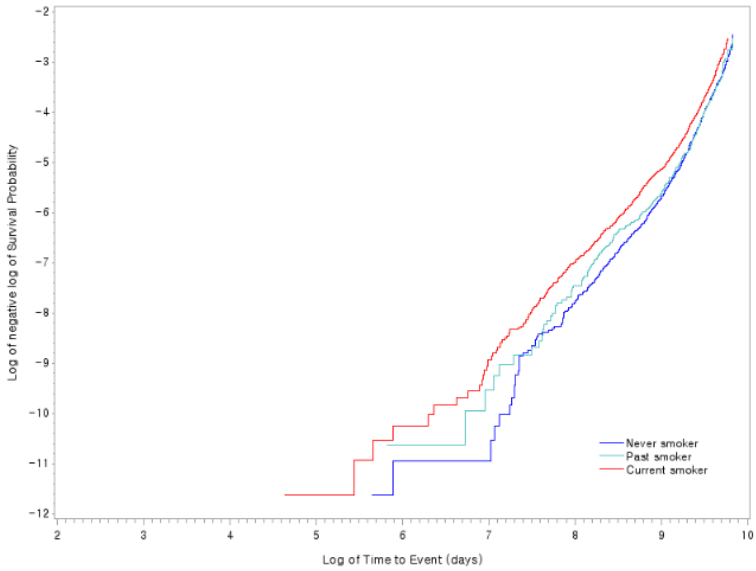
Appendix Figure 2. Survival plot (A) and log-log survival plot (B)

stratified by baseline smoking status for external causes of death using age as time scale in women

A) (time to Event 0 means the age of 40)

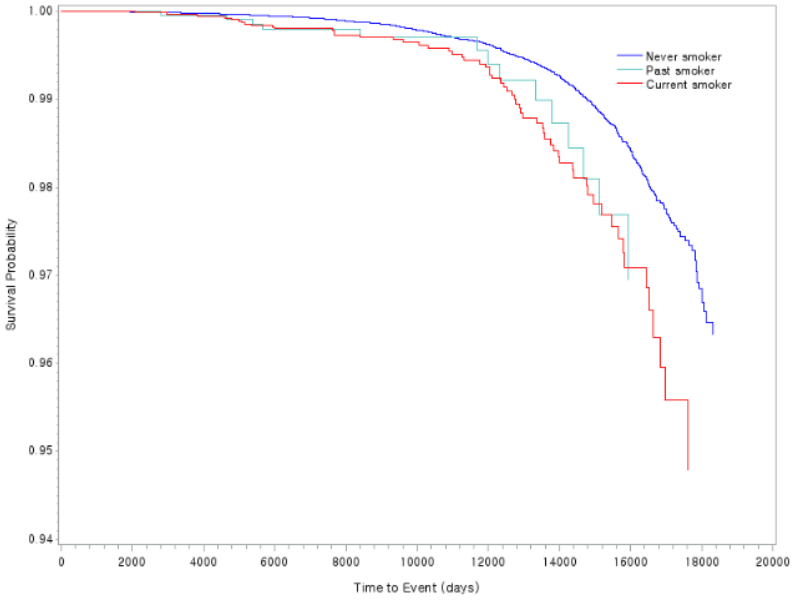


B) with zph 0.2395(past smoker) and 0.0006(current smoker)

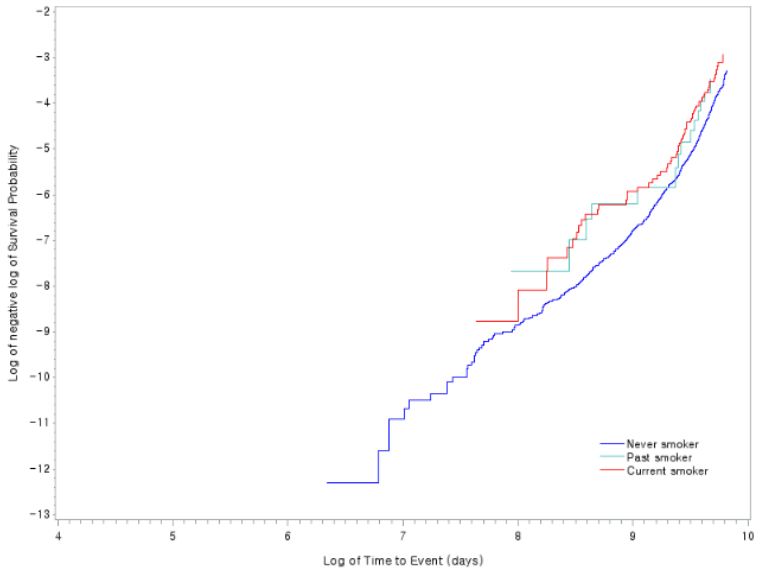


Appendix Figure 3. Survival plot (A) and log-log survival plot (B) stratified by baseline smoking status for unintentional injury death using age as time scale in men

A) (time to Event 0 means the age of 40)



B) with zph 0.4852(past smoker) and 0.4126(current smoker)



Appendix Figure 4. Survival plot (A) and log-log survival plot (B) stratified by baseline smoking status for unintentional injury death using age as time scale in women

흡연과 비의도적 사고사 위험성 분석: 전국인구기반 코호트 연구

지도교수 김현창

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백종민

[연구 배경 및 목적] 외인사(사망의 외인)는 전세계적으로 연간 전체 사망자의 거의 8%를 차지한다. 흡연과 외인사의 연관성에 대한 이전의 연구들이 있었으나, 대부분은 외인사 중 자살에 초점이 맞춰져 있었다. 그러나 비의도적 사고사와 흡연과의 연관성은 충분히 조사되지 않았다. 따라서 우리는 국민건강보험 데이터베이스를 이용하여 흡연 상태가 비의도적 사고사 및 기타 외인사에 미치는 장기적, 단기적 영향을 조사하였다.

[방법] 우리는 2002년과 2003년에 국민건강보험공단 일반건강검진(NHIS-HEALS)을 수

검한 40세에서 79세 사이의 대한민국 국민 493,031명을 분석대상자로 선정했다. 비의도적 사고사 및 기타 외인사의 위험도는 시간 종속 변수를 사용하거나 사용하지 않은 콕스 비례 위험 모델을 사용하여 추정되었으며, 남녀로 구분하여 위험비와 95% 신뢰구간으로 표현했다. 흡연상태는 '비흡연자', '과거흡연자', '현재흡연자'로 분류되었다. 시간 종속 콕스 회귀분석에서는 사건 발생 시 흡연 상태를 위와 같이 세 종류로 분류하였다. 모든 사망은 한국표준질병사인분류 코드를 이용하여 평가되었다. 외인사는 비의도적 사고사, 자살, 타살로 분류된다. 비의도적 사고사는 교통 사고사, 추락사, 익사, 질식사, 화재사, 중독사, 그리고 기타 비의도적 사고사와 같이 7가지 하위 범주로 더 분류된다. 보정 변수로는 연령, 음주, 고혈압, 당뇨병, 찰슨 동반상병지수, 소득 수준 및 장애 정도가 사용되었다.

[결과] 남녀 모두에서 현재흡연자는 비흡연자에 비해 외인사 위험이 더 높았고(남성 HR=1.25, 95%CI=1.16-1.34; 여성 HR=1.85, 95%CI=1.49-2.30), 비의도적 사고사 위험(남성 HR=1.14, 95%CI=1.04-1.25; 여성 HR=1.95, 95%CI=1.50-2.54), 자살 위험(남성 HR=1.44, 95%CI=1.28-1.61; 여성 HR=1.60, 95%CI=1.08-2.38)도 더 높았다. 시간 종속 콕스 회귀 분석을 사용할 때, 결과는 기존 콕스 회귀 분석의 결과와 거의 같았다. 시

간 종속 콕스 회귀 분석에서, 사고당시 현재흡연자는 사고당시 비흡연자에 비해 외인사 위험이 더 높았고(남성 HR=1.44, 95%CI=1.34-1.54; 여성 HR=1.64, 95%CI=1.28-2.11), 비의도적 사고사 위험(남성 HR=1.27, 95%CI=1.16-1.39; 여성 HR=1.61, 95%CI=1.17-2.21), 자살 위험(남성 HR=1.76, 95%CI=1.57-1.97; 여성 HR=1.67, 95%CI=1.06-2.57)도 더 높았다. 사고사 하위 그룹에서, 현재흡연자는 비흡연자에 비해 남성의 질식사 위험(HR=2.41, 95%CI=1.38-4.21), 여성의 추락사 위험(HR=2.59, 95%CI=1.29-5.21) 및 기타 사고사 위험(HR=2.54, 95%CI=1.73)이 높았다. 시간 종속 콕스 회귀 분석에서, 사고당시 현재흡연자는 사고당시 비흡연자에 비해 남성의 교통사고사 위험(HR=1.17, 95%CI=1.03-1.33), 질식사 위험(HR=1.97, 95%CI=1.15-3.40), 기타 사고사 위험(HR=1.36, 95%CI=1.14-1.62)이 높았고, 여성의 기타 사고사 위험(HR=1.91, 95%CI=1.17-3.11)이 높았다. 위의 통계적으로 유의한 결과를 가진 사고사 하위 그룹에서, 교통사고사를 제외한 다른 하위 그룹들은 모두 흡연강도와 각각의 사고사 위험에 있어서 용량반응관계를 보였다. 사고당시 과거흡연자는 사고당시 비흡연자에 비해 남성의 질식사 위험과 여성의 기타 사고사 위험이 더 높았다.

[결론] 요약하자면, 흡연은 장기적, 단기적으로 외인사, 비의도적 사고사, 자살의 위험

증가와 관련이 있다. 장기적으로, 현재 흡연은 남성의 질식사 위험, 여성의 추락사 위험 및 기타 사고사 위험이 높았다. 단기적으로, 사고 당시의 흡연은 남성의 교통사고사, 질식사, 기타 사고사의 위험을 높이며, 여성의 기타 사고사의 위험을 높인다. 금연 후에도 비의도적 사고사의 위험은 줄어들기 때문에, 흡연율을 줄이는 정책뿐 아니라 위험한 업무나 운전을 하고 있을 경우 흡연을 금지하는 정책 등이 고려된다면, 산업재해를 포함한 비의도적 사고사를 줄이는데 효과적일 것이다.

핵심이 되는 말: 흡연, 금연, 사고, 사고사, 비례 위험 모델