Smoking and cancer risk in Korean men and women

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Abstract

Objective: In Korea, male smoking prevalence is among the world's highest, and mortality rates from smoking-caused cancers, particularly lung cancer, are escalating. This cohort study examined the effects of cigarette smoking on the risk of cancer mortality and incidence, and characterized the relationship of cancer risk with the amount and duration of cigarette smoking.
Method: A nine-year prospective cohort study was carried out on 1,212,906 Koreans, 30–95 years of age. The study population includes participants in a national insurance program, who completed a questionnaire on smoking and other risk factors. The main outcome measures were death from cancer and cancer incidence, obtained through record linkage. At baseline, 472,970 men (57.0%) and 20,548 (5.4%) women were current cigarette smokers.
Results: In multivariate Cox proportional hazards models, controlling for age, current smoking among men increased the risks of mortality for cancer of the lung (relative risk (RR), 4.6; 95% confidence interval (CI), 4.0–5.3) and other cancers, including larynx, bile duct, esophagus, liver, stomach, pancreas, bladder, and also leukemia. Current smoking among women increased the risk of lung cancer mortality (RR = 2.5, 95% CI = 2.0–3.1). Similar results were found for incidence among men and women.
Conclusion: In Korea, smoking is an independent risk factor for a number of major cancers. The findings affirm the need for aggressive tobacco control in Korea in order to minimize the epidemic of smoking-caused disease.

Introduction

In Korea, even though tobacco was introduced 400 years ago, widespread use in the form of manufactured cigarettes dates only to 1945. The first national brand, produced by a government monopoly, was named 'Seung Ri', meaning independence from Japan. Cigarette consumption has risen sharply since the Korean War ended in 1953; the rise has been particularly pronounced since 1960 as Korea became economically prosperous (Figure 1). By 2000, the smoking prevalence was 68% among men and 3% among women [1]. Cigarettes are still largely produced locally by the

government monopoly, while foreign brands are just entering the market [2, 3].

The national mortality rates show the anticipated effects of smoking on disease occurrence over time. Since 1980, lung cancer mortality has been the most rapidly increasing cause of death among Koreans, rising from 2.1 per 100,000 in 1980 to 33 per 100,000 in 2000 among men and from 1.4 per 100,000 in 1980 to 13.5 per 100,000 in 2000 among women [4]. For major diseases other than cancer that are also caused by smoking, mortality rates are increasing.

Cigarette smoking is widely recognized as a major risk factor for lung cancer in Western countries [5–8]. Nonetheless, few studies have examined the risks of smoking on cancer mortality and incidence in Korea [9, 10], although some studies on the risks of smoking have been reported from other Asian countries, including

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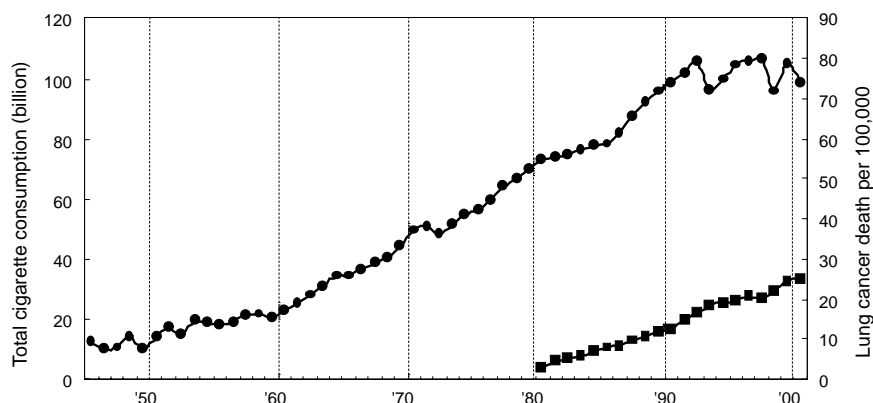
Fig. 1. Total cigarette consumption and lung cancer mortality in Korea, 1945–2000 Source: Korea Tobacco & Ginseng Corporation, 2000.

China [11–13], Japan [14–17], Hong Kong [18] and India [19]. In Korea, employees of the government as well as teachers in private schools participate in the Korean Medical Insurance Corporation (KMIC), now a part of the National Health Insurance Corporation (NHIC). We have used data on these insurance plan participants, who answer questionnaires periodically on disease risk factors, to form the study population for a prospective cohort study of smoking and cancer. We have labeled this study as the Korean Cancer Prevention Study (KCPS). Our goals were to assess the extent to which smoking increases cancer risk in Korean smokers and to characterize dose–response relationships with amount and duration of smoking, for comparison to findings in other countries and to characterize the tobacco epidemic in Korea for the purpose of national tobacco control.

Materials and methods

Study participants

The NHIC provides health insurance to government employees, teachers, and their dependents. Of the entire Korean population – approximately 43.7 million in 1992 – 4,662,438 (10.7%) were insured by the KMIC, including 1,297,833 workers and their 3,364,605 dependents. All insured workers are required to participate in biennial medical examinations [20]. In 1992, 94% of the insured workers completed the biennial examinations; a total of 95% completed the biennial examinations in 1994. For dependents, the numbers were 37% (1993) and 24% (1995), respectively.

The KCPS is a prospective cohort study, designed to assess risk factors for mortality, incidence, and hospital admission from cancer, with a follow-up of nine years. The KCPS cohort includes the 1,307,275 Koreans

(833,608 men and 473,667 women) from 30 to 95 years of age who received health insurance from the KMIC and who had biennial medical evaluations in 1992–1995. Of the study participants, 781,210 (64.4%) were enrolled in 1992, 306,754 (25.3%) in 1993, 98,152 (8.1%) in 1994, and 26,790 (2.2%) in 1995. Of the 1,307,275 participants, 87,491 smokers (6.7%) with incomplete data on the amount and/or duration of smoking were excluded. Excluded from the analysis were a total of 3,439 people who reported a history of any form of cancer and 3,339 who died in the interval between questionnaire completion and start of follow-up on January 1 of the subsequent year, leaving a final sample of 1,212,906.

Data collection

The NHIC biennial examinations follow a standard procedure and are conducted by medical staff at local hospitals. In the 1992, 1993, 1994, and 1995 questionnaires, participants were asked to describe their smoking habits, including the number of cigarettes smoked per day and the duration of cigarette smoking in years, along with other health habits, including alcohol consumption. The completed questionnaires were reviewed and edited by trained staff and then entered into an electronic database. The data were edited further during analysis.

From data collected in the baseline examination, the participants were classified as 'current' smokers if they reported smoking currently for at least one year, 'never-smokers' if they had never smoked, and 'ex-smokers' if they had smoked but had quit. Current smokers were further classified by the average number of cigarettes smoked per day (1–9, 10–19 and 20 or greater cigarettes per day) and duration of smoking (1–9, 10–19, 20–29, and 30 or more years). The follow-up period was up to nine years from January 1, 1993 to December 31, 2001,

and the smoking history was not updated from baseline during follow-up. The exact dates of completion of the survey form were not recorded. Consequently, follow-up accrual began on January 1 of the calendar year following the year in which the survey form was completed. Persons who completed a survey but died within the calendar year of the survey were excluded.

Cancer outcomes

The principal outcome variables were mortality from cancer by site, and cancer incidence by site, based on both national cancer registry data and hospitalization records. While Korea has a national cancer registry, reporting is incomplete and does not capture all incident cases. Consequently, hospital admission files were used to identify a first admission event for cancer. In Korea, professionally trained and certified medical chart recorders abstract charts and assign discharge diagnoses and codes in a standardized fashion. An incident cancer case was coded as occurring based on either a positive report from the national cancer registry or on a hospital admission for a cancer diagnosis. Follow-up was initiated based on the time of the earliest event. Outcomes for mortality were ascertained from the causes of death on the death certificates. A computerized search of death certificate data from the National Statistical Office in Korea was performed using the unique identification number assigned at birth. Causes of death are assigned at the hospitals by trained abstractors.

All cancers were classified according to the 9th and 10th revisions of the International Classification of Disease.

In a random sample (n = 100) of lung cancer cases that occurred in the Korea Medical Insurance Corporation enrolees, we confirmed with a medical chart review that 95.7% of lung cancer diagnoses were valid [21].

Statistical analysis

All mortality and incidence rates were age-standardized to the Korean national population of 1995. The Cox proportional hazards model was used to assess the independent effects of smoking status, either current or former, on cancer occurrence (mortality or incidence), controlling for age. To calculate the population attributable risk (PAR) for cigarette smoking, we used Levin's formula [22] with generalization to the two strata of smoking status [23]. Lastly, a birth cohort analysis was performed to investigate trends in the smoking status of the study population during past decades. For the birth cohort, we defined four strata by decade of birth year; 1953–1962, 1943–1952, 1933–1942, and 1923–1932.

Results

Cohort characteristics

The majority of cohort members were middle-aged, but there were 162,536 participants aged 60 years and above. The mean (SD) age of the study participants was 45.0 (10.9) years among men and 48.6 (12.4) years among women. Most men in the KCPS were smokers, while only a small percentage of women reported smoking (Table 1). At baseline, 472,970 men (57.0%) and 20,548 (5.4%) women were current cigarette smokers. By age, the greatest percentage of heavy smokers was among younger males, while the percentage of former smokers rose with increasing age. By birth cohort, a strong trend exists towards an earlier age of starting to smoke for the later birth cohorts (Figure 2). Most current smokers consumed less than one pack of cigarettes per day. Because of the small numbers of reported smokers, patterns by age could not be identified in women. Among the male current smokers, 46.2% had been

Table 1. Prevalence (%) of cigarette smoking by age group in men and women

Age group (n)	Men (n = 830,139)					Women (n = 382,767)				
	Never smokers	Former smokers	Current smokers, cigarette per day			Never smokers	Former smokers	Current smokers, cigarette per day		
			1–9	10–19	≥20			1–9	10–19	≥20
30–39 (417,954)	20.1	19.1	15.1	27.2	18.5	99.5	0.4	0.1	0.0[a]	0.0[a]
40–49 (338,361)	20.8	23.3	13.7	24.6	17.7	98.0	0.6	0.8	0.4	0.2
50–59 (294,055)	23.6	24.6	15.4	22.2	14.3	95.0	1.3	2.0	1.3	0.4
≥ 60 (162,536)	23.0	28.8	16.2	21.7	10.4	80.6	6.5	7.2	4.4	1.4
Total	20.1	23.0	15.2	25.1	16.7	92.1	2.5	3.0	1.8	0.6

[a] 38 reported smoking at 10–19 and 22 at ≥20 cigarettes.

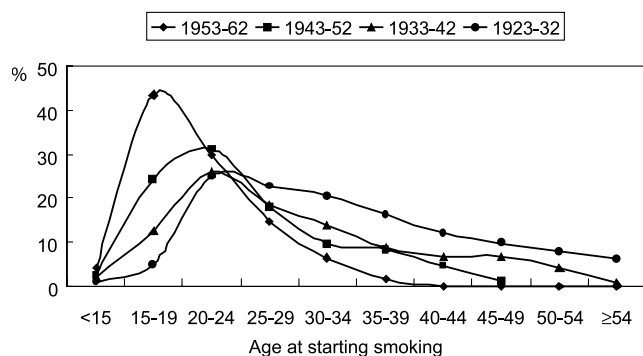*Fig. 2.* Age of starting to smoke by decade of birth year in Korean men. *Source*: *National Health Insurance Corporation, 2000.*

those cancers causally linked to smoking: esophagus, stomach, liver, pancreas, larynx, lung, bladder, and leukemia. Mortality rates and relative risks were generally lower for former smokers than for current smokers. The highest relative risks were for cancers of the larynx, lung, and esophagus.

For cancers of the stomach, pancreas, liver, and lung, there were sufficient deaths to jointly assess the effects of amount smoked and duration of smoking on the risk of cancer death (Figures 3–5). For cancer of the lung (Figure 3), relative risk increased with both duration and amount of smoking. Compared with never smokers in men, the RR (95% CI) of lung cancer for current smokers who smoked 20 cigarettes per day for over
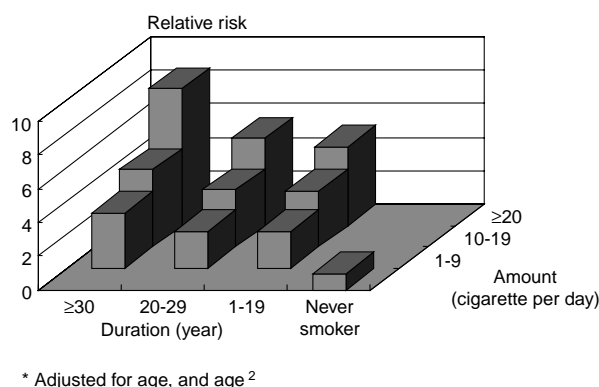
smoking for over 20 years, and 26.6, 44.1 and 29.3% smoked 1–9, 10–19, and 20 or more cigarettes per day, respectively. Among the female current smokers, 64.2% had been smoking for over 20 years, and 55.3, 33.9 and 10.8% smoked 1–9, 10–19, and 20 cigarettes per day, respectively.

Smoking and cancer mortality

During the follow-up interval, there were 15,214 cancer deaths in men and 3,019 in women for all sites combined. Table 2 provides site-specific cancer mortality rates by smoking status and relative risk estimates for men. The numbers of deaths were substantial in most strata. Smokers had higher mortality rates for most of

Fig. 3. Age adjusted relative risk of mortality for cancer of the lung with the amount and duration of cigarette smoking among men.

Table 2. Age adjusted mortality rate (per 100,000) and relative risk of cigarette smoking for various cancers in Korean men, 1993–2001

Cancer site	Mortality per 100,000 person year (number)			Current smoker versus never smoker	Former smokers versus never smoker
	Never smoker (n = 166,411)	Former smoker (n = 190,758)	Current smoker (n = 472,970)	RR (95% CI)	RR (95% CI)
Esophagus	4.0 (44)	7.0 (126)	12.4 (441)	3.6 (2.6–4.9)	1.9 (1.4–2.7)
Stomach	39.9 (483)	55.4 (1003)	61.3 (2141)	1.6 (1.4–1.7)	1.4 (1.3–1.6)
Colon	7.1 (91)	7.8 (139)	8.2 (281)	1.1 (0.8–1.4)	1.1 (0.9–1.4)
Liver	48.4 (668)	64.1 (1183)	59.8 (2298)	1.2 (1.1–1.3)	1.3 (1.2–1.5)
Bile duct	6.7 (82)	7.0 (126)	9.6 (337)	1.5 (1.2–1.9)	1.1 (0.8–1.4)
Pancreas	9.2 (119	11.9 (216)	13.2 (471)	1.4 (1.2–1.6)	1.3 (1.0–1.6)
Larynx	0.8 (9)	2.7 (49)	4.9 (165)	6.5 (3.3 –12.8)	3.6 (1.8–7.3)
Lung	19.2 (212)	40.2 (708)	82.5 (2733)	4.6 (4.0–5.3)	2.2 (1.9–2.6)
Prostate	3.6 (31)	3.0 (51)	3.4 (106)	1.2 (0.8–1.8)	1.0 (0.7–1.6)
Kidney	2.7 (32)	3.2 (56)	2.4 (90)	1.0 (0.7–1.5)	1.2 (0.8–1.9)
Bladder	2.1 (20)	2.8 (50)	3.3 (105)	1.9 (1.2–3.0)	1.6 (0.9–2.6)
Brain	2.9 (41)	3.0 (56)	3.2 (115)	1.1 (0.8–1.5)	1.1 (0.7–1.5)
Thyroid	0.5 (5)	0.6 (11)	0.4 (16)	1.2 (0.5–3.0)	1.6 (0.6–4.4)
Leukemia	3.5 (47)	4.8 (83)	4.7 (174)	1.3 (1.0–1.8)	1.4 (1.0–1.9)

RR (95% CI): relative risk (95% confidence interval).
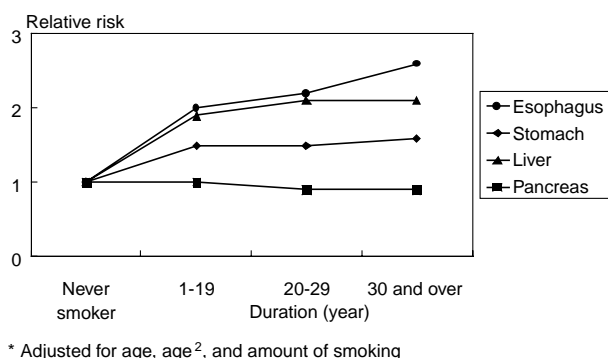
Fig. 4. Relative risk of cancers of esophagus, stomach, liver and pancreas by duration of smoking.
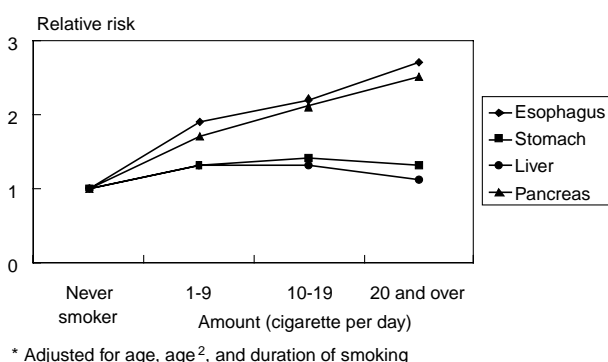

Fig. 5. Relative risk of cancers of esophagus, stomach, liver and pancreas by amount of smoking.

30 years was 8.1 (7.1–9.2) (Figure 3). Numbers were sufficient for cancers of the esophagus, stomach, liver and pancreas to explore dose-response relationship with duration of smoking (Figure 4) and amount of smoking (Figure 5). Relative risk increased for each site, except

pancreas, with duration, and with amount for esophagus and stomach cancer.

For women, the numbers of deaths limited the analysis to cancers of the stomach, liver, pancreas, lung, breast, and cervix (Table 3). The risk for lung cancer was significantly increased in current and former smokers. Risks were not increased for the other sites.

For smoking in men, we estimated the population attributable risks for major cancers (lung, stomach, liver and pancreas), using smoking prevalence estimates from this study. Smoking, including both current and former smokers, accounted for 72.5% of lung cancer deaths, 31.5% of stomach cancer deaths, 14.5% of liver cancer deaths, and 23.7% of pancreas cancer deaths.

Smoking and cancer incidence

During the follow-up interval, for all sites combined, there were 25,020 cancer incidence events in men and 4,919 in women. Table 4 provides site-specific cancer incidence rates by smoking status and also relative risk estimates for men. The numbers of incidence events were substantial in most strata. Smokers had higher incidence rates for most of those cancers causally linked to smoking: esophagus, stomach, liver, pancreas, larynx, lung, kidney, and bladder. Overall, regarding the association between smoking and incidence, similar results were found in men and women. However, relative risk estimates tended to be somewhat lower than for mortality. Incidence rates and relative risks were generally lower for former smokers than for current smokers. The highest relative risks were for cancers of the larynx, lung, and esophagus.

For women, the numbers of incident cases limited the analysis to cancers of the stomach, liver, pancreas, lung, breast, and cervix (Data not shown). The risk for lung cancer was significantly increased in current smokers

Table 3. Age adjusted mortality rate (per 100,000) and relative risk of cigarette smoking for various cancers in Korean women, 1993–2001

Cancer site	Mortality per 100,000 person year (number)			Current smoker versus never smoker	Former smokers versus never smoker
	Never smoker (n = 352,512)	Former smoker (n = 9,707)	Current smoker (n = 20,548)	RR (95% CI)	RR (95% CI)
Stomach	25.2 (718)	24.9 (62)	19.4 (101)	0.9 (0.7–1.1)	1.0 (0.8–1.3)
Liver	14.3 (429)	23.0 (41)	15.2 (58)	1.0 (0.7–1.3)	1.3 (0.9–1.8)
Pancreas	7.7 (222)	6.8 (15)	12.6 (43)	1.2 (0.9–1.7)	0.8 (0.4–1.3)
Lung	13.2 (399)	20.5 (50)	29.6 (136)	2.5 (2.0–3.1)	1.7 (1.2–2.3)
Breast	6.5 (189)	6.4 (8)	30.3 (8)	0.8 (0.4–1.8)	1.7 (0.8–3.6)
Cervix	2.6 (79)	1.3 (8)	3.4 (14)	1.7 (0.9–3.1)	1.9 (0.9–4.0)

RR (95% CI): relative risk (95% confidence interval).

Table 4. Age adjusted incidence rate (per 100,000) and relative risk of cigarette smoking for various cancers in Korean men, 1993–2001

Cancer site	Incidence per 100,000 person year (number)			Current smoker versus never smoker	Former smokers versus never smoker
	Never smoker (n = 166,411)	Former smoker (n = 190,758)	Current smoker (n = 472,970)	RR (95% CI)	RR (95% CI)
Esophagus	5.3 (68)	8.4 (154)	16.2 (596)	3.1 (2.4–4.0)	1.6 (1.2–2.1)
Stomach	77.7 (1022)	109.9 (2006)	116.1 (4288)	1.5 (1.4–1.6)	1.4 (1.3–1.5)
Colon	25.2 (342)	28.0 (509)	21.1 (782)	0.8 (0.7–1.0)	1.1 (1.0–1.3)
Liver	65.2 (932)	83.3 (1544)	72.5 (2837)	1.1 (1.0–1.2)	1.3 (1.2–1.4)
Bile duct	8.7 (106)	11.1 (203)	11.3 (403)	1.4 (1.1–1.8)	1.4 (1.1–1.8)
Pancreas	9.0 (120)	12.4 (229)	14.0 (514)	1.5 (1.2–1.8)	1.4 (1.1–1.7)
Larynx	1.9 (27)	6.7 (122)	10.3 (377)	5.4 (3.5–8.1)	3.3 (2.1–5.1)
Lung	24.2 (308)	49.6 (879)	95.5 (3258)	4.0 (3.5–4.4)	2.0 (1.7–2.3)
Prostate	12.7 (145)	14.5 (259)	10.9 (344)	0.8 (0.6–1.0)	1.0 (0.9–1.4)
Kidney	9.3 (128)	10.9 (194)	8.2 (324)	1.3 (1.0–1.5)	1.2 (0.9–1.6)
Bladder	9.2 (111)	15.5 (277)	17.6 (638)	2.0 (1.7–2.5)	1.8 (1.4–2.2)
Brain	3.9 (61)	6.2 (109)	4.5 (178)	1.0 (0.7–1.2)	1.3 (0.9–1.8)
Thyroid	4.5 (67)	4.6 (82)	3.0 (122)	0.6 (0.5–1.0)	1.0 (0.7–1.4)
Leukemia	4.7 (62)	6.2 (113)	4.7 (180)	1.1 (0.8–1.5)	1.4 (1.0–2.0)

RR (95% CI): relative risk (95% confidence interval).

(RR = 2.2, 95% CI, 1.8–2.7). Risks were not increased for the other sites.

Discussion

In this large prospective cohort study of, we documented that cigarette smoking is a risk factor in men for cancers of the esophagus, stomach, liver, bile duct, pancreas, larynx, lung, and bladder, and for leukemia and in women for lung cancer. These are cancers that have been causally linked to smoking [6, 24]. The increased risks in smokers were evident, particularly for lung cancer, even though smoking was generally light until the 1960s and 1970s (Figure 1), and the majority of smokers in the KCPS still consume less than one pack per day. Estimates of attributable risks show that smoking accounts for a substantial fraction of deaths for some cancers in Korean men (*i.e.*, 73% of lung cancer deaths).

These findings are not surprising, as the risks of cancer associated with smoking have been documented in large cohort studies conducted throughout the world [6, 24, 25]. Studies in western countries have generally shown higher relative risks than those observed in this first follow-up of the KCPS. For example, in the 40-year follow-up of the British doctors' cohort, extending to 1991, the relative risks for death in male current smokers were 14.9 for lung cancer, 1.7 for stomach cancer, and 2.3 for bladder cancer [8]. As a further comparison, the relative risks for cancer mortality in current smokers in

the American Cancer Society's Cancer Prevention Study II (CPS II) were 22.4 and 9.4 for men and women, respectively, for lung cancer and 2.1 and 1.1, respectively, for pancreatic cancer [8].

The lower risks in the KCPS, in comparison with these and other western cohorts [6, 8, 24, 25] are consistent with temporal trends of smoking in Korea (Figures 1 and 2). Even though cigarette consumption has been rising rapidly (Figure 1), most smokers still smoke less than one pack per day (Table 1) and on average, by birth cohort, only the most recent cohorts started smoking during adolescence. Risk for smoking-related cancers varied with both amount and duration of smoking (Figure 4 and 5) and for lung cancer, the risk rose more sharply with amount smoked. For lung cancer, an analysis of the data from the British doctors' study suggests that duration has a substantially greater effect on risk than does amount smoked [26]. The different findings may reflect the much heavier smoking of the group included in this analysis of the British doctors' study.

The comparatively low overall relative risks for smokers in KCPS are currently driven by the low-risk smoking profile of the older participants in the cohort, who now make up most cancer deaths and cases. Unfortunately, the earlier age of starting and greater amount smoked among younger men in KCPS predict rising risks on further follow-up, as do national data on smoking patterns [27]. Comparing the national survey data for 1980 to 2000, a similar national pattern of increasing consumption is evident with the average

number of cigarettes smoked by men increasing from 11.2 to 23.7 per day and an increase from 5.7 to 16.6 per day in women [27].

The results of the present study are in agreement with other epidemiological data on cancer and smoking in Korea [9, 10]. Choi *et al.* [10] were the first to report associations of smoking with cancer risk, based on a study of the case–control design conducted in the Korean Cancer Center Hospital in 1992. They found significant associations of smoking with cancers of the larynx (OR = 5.4; 95% CI = 2.1–14.3), lung (OR = 5.8, 95% CI = 3.1–10.9), and esophagus (OR = 1.9, 95%, CI = 1.1–2.8), but not with cancers of the stomach (OR = 1.3, 0.9–2.0) and liver (1.0, 95% CI = 0.7–1.6). Subsequently, there has been one prospective cohort study of a selected sample of the male participants from NHIC [10]. The study found an increased risk for lung cancer death (RR = 5.6, 95% CI = 4.2–7.3) comparing smokers with nonsmokers. In comparison with the present study, however, this study [10] did not include incidence data and had a more limited sample size (n = 300,000) and shorter follow-up (six years), included only men, and did not cover other cancers. There have not yet been cohort studies of smoking and cancer in women in Korea. The present study, with its size and inclusion of both men and women, will provide a platform for tracking smoking and disease risk in Korea.

The smoking patterns and relative risks observed for cancer in the KCPS are similar to those found in other Asian countries. In general, smoking has been highly prevalent among Asian males, but the number of cigarettes smoked per day was low and then began to rise in the 1960s and 1970s. Recent reports from China [10–13], Japan [14–17], Hong Kong [18] and India [19] provide relative risk estimates for cancer deaths associated with smoking comparable with those observed in the KCPS.

In summary, cohort and case–control studies in Asia, including this new study in Korea, show a clear and strong effect of smoking on lung cancer risk but the effect is consistently lower in Asian countries than in studies of smokers in several western countries [6, 8, 25]. However, studies of cancers of stomach and liver have not yielded a similarly consistent picture of increased risk, even though both of these cancers have recently been classified by the International Agency for Research on Cancer as caused by smoking [24]. For stomach cancer, the present study did find a significant association in men, as have other studies in Asia [6, 14]. In other studies, a significant association has not been found [9, 11, 28]. The evidence has been similarly mixed for liver cancer; increased risk in smokers has been found in several studies [28], including the present study, but not in others [6, 28]. These inconsistencies across studies may be explained by different smoking patterns, by approaches to handling possible confounding factors, particularly alcohol consumption for liver cancer, and by differing patterns of potential effect modifiers, including not only alcohol but hepatitis. The International Agency for Research on Cancer concluded that these factors had been sufficiently taken into account in concluding that smoking causes liver cancer and stomach cancer [24].

The potential limitations of our study arise primarily from the use of data collected as part of an insurance plan. The questionnaires provide self-reported smoking information without validation, and we are concerned that smoking is under-reported by women, as a result of social norms around the issue of smoking. The possible under-reporting appears to be greatest for the youngest participants (Table 1) who contribute few outcome events. Additionally, we used smoking on the baseline questionnaire without reclassification if smoking status changed on subsequent questionnaires; we did so for computational ease and because updated smoking histories were not uniformly available. For 666,288 men who answered a questionnaire in both 1992 and 1994, there was 90% agreement overall between the two instruments. Mortality statistics on cancer have potential limitations that have been well-characterized in some countries [6, 8]; while we are uncertain if these findings apply in Korea, a pilot for lung cancer showed high concordance between death certificate and clinical information. In Korea, cancer registration is not yet complete nationwide, and consequently we used hospital admission for cancer as a further indication of cancer incidence.

In interpreting the findings, consideration needs to be given to the characteristics of the KCPS participants. First, the study participants tended to be middle-class, employed individuals, who may be healthier than the general population in Korea. The smoking prevalence in the males in the study was somewhat lower (57 versus 68%) than in the 2000 national survey, likely reflecting the generally higher educational level of the cohort. Second, the KCPS participants were primarily middle-aged (Table 1), so that the patterns of risk found in this follow-up may not represent those in older Koreans, now experiencing the highest rates of cancer and other smoking-caused diseases. On the other hand, we have established the feasibility of follow-up of the KCPS cohort and the study will contribute further follow-up of the older ages over time.

Unfortunately, the current findings in the KCPS, taken in the context of findings on the risk of smoking in

other countries, predict a rising epidemic of smoking-caused cancer in Korea. Our results only reinforce that aggressive tobacco control is needed in Korea. At present, tobacco control efforts are underway, but inadequate in scope, given the magnitude of the problem. Strong, evidence-based programs are needed to promote tobacco control, including preventing initiation, promoting cessation, increasing the prices of tobacco products, and reducing exposure to environmental tobacco smoke. Otherwise, the health burden from smoking-caused cancer among Koreans will increase in the near future, following the predictable course seen in Western countries.

Acknowledgements

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