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RESEARCH PAPER

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Background: Although the harms of smoking are well established, it is unclear how they extend into old age in the Chinese.
Aim: To examine the relationship of smoking with all-cause and major cause-specific mortality in elderly Chinese men and women, respectively, in Hong Kong.
Methods: Mortality by smoking status was examined in a prospective cohort study of 56 167 (18 749 men, 37 416 women) Chinese aged ⩾65 years enrolled from 1998 to 2000 at all the 18 elderly health centres of the Hong Kong Government Department of Health.
Results: After a mean follow-up of 4.1 years, 1848 male and 2035 female deaths occured among 54 214 subjects (96.5% successful follow-up). At baseline, more men than women were current smokers (20.3% vs 4.0%) and former smokers (40.8% vs 7.9%). The adjusted RRs (95% CI) for all-cause mortality in former and current smokers, compared with never smokers, were 1.39 (1.23 to 1.56) and 1.75 (1.53 to 2.00) in men and 1.43 (1.25 to 1.64) and 1.38 (1.14 to 1.68) in women, respectively. For current smokers, the RRs (95% CI) for all-cause mortality were 1.59 (1.39 to 1.82), 1.72 (1.48 to 2.00) and 1.84 (1.43 to 2.35) for daily consumption of 1–9, 10–20 and >21 cigarettes, respectively (p for trend <0.001). RRs (95% CI) were 1.49 (1.30 to 1.72) and 2.20 (1.88 to 2.57) in former and current smokers for all deaths from cancer, and 1.24 (1.04 to 1.47) and 1.57 (1.28 to 1.94) for all cardiovascular deaths, respectively. Quitters had significantly lower risks of death than current smokers from all causes, lung cancer, all cancers, stroke and all cardiovascular diseases.
Conclusions: In old age, smoking continues to be a major cause of death, and quitting is beneficial. Smoking cessation is urgently needed in rapidly ageing populations in the East.

Many Western prospective studies have shown that much of the all-cause mortality, including lung cancer, cardiovascular disease (CVD) and chronic obstructive pulmonary disease (COPD) are caused by cigarette smoking.[1–3] Globally, tobacco-related deaths are rising, mainly because of increasing cigarette consumption in developing countries, especially China.[4]

Prospective studies of smoking and mortality in China are few,[5–9] and evidence from elderly people, especially women, is sparse. Some Western studies have found a lower risk of mortality from smoking in old age than in middle age.[10 11] Prospective studies are needed to monitor the growing tobacco epidemic particularly in rapidly developing regions and rapidly ageing populations. However, these populations, including mainland Chinese, are mostly in the early stage of the epidemic, and prospective studies[8] would underestimate the risks, especially in elderly smokers. In Hong Kong, with a largely ethnic Chinese population, tobacco consumption reached its peak about 20 years earlier than in mainland China, but about 20 years later than in developed Western countries, such as the US.[12–14] Evidence from elderly Chinese in Hong Kong can forewarn what will happen to their counterparts in the rest of China and also in other developing Asian countries. Only two papers, one from a large community-based case–control study[14] and the other from a small prospective study,[15] have reported the association between smoking and mortality in elderly Chinese in Hong Kong. This prospective study examined the relationship of smoking with all-cause and major cause-specific mortality in elderly Chinese men and women, respectively, in Hong Kong.

METHODS

Sample

Since July 1998, 18 Elderly Health Centres have been established to provide health examination and primary care services by the Department of Health of the Government of the Hong Kong Special Administrative Region. All elderly people aged ⩾65 years were encouraged to enroll at a nominal fee, which was waived for the poor. All 56 167 clients who first enrolled from July 1998 to December 2000 were included, almost all were community-dwelling older people and a minority lived in institutions (4.3%). Details of the methods have been reported previously.[16 17] Smoking was defined as "at least one cigarette per day continuously for at least 1 year". Current smokers were people who had ever smoked and who were still smoking at baseline. Former smokers were ever smokers who had stopped smoking for at least 1 year. Never smokers were those who had never smoked at least one cigarette a day continuously for at least 1 year.

Follow-up

Vital status and causes of death by 31 December 2003 were ascertained from official death registration, specialist outpatient and hospitalisation databases by linking the unique identity card number of every client. Failing these, the subjects were followed up by telephone interview from November 2004 to January 2005. This yielded a mean (SD) follow-up duration of 4.1 (0.9) years among 54 216 subjects, with 1951 (3.5%) lost

Abbreviations: COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease

Table 1 Baseline characteristics of 54 214 clients in Elderly Health Centres in Hong Kong by sex and smoking status

Characteristics	Men				Women			
	Never smoker, n (%)	Former smoker, n (%)	Current smoker, n (%)	χ^2 p Value	Never smoker, n (%)	Former smoker, n (%)	Current smoker, n (%)	χ^2 p Value
Sex	7072 (38.9)	7455 (41.0)	3635 (20.0)		31767 (88.1)	2853 (7.9)	1432 (4.0)	
Age (years)				<0.001				<0.001
65–69	3043 (43.0)	2520 (33.8)	1497 (41.2)		13127 (41.3)	681 (23.9)	463 (32.3)	
70–74	2156 (30.5)	2487 (33.4)	1218 (33.5)		9595 (30.2)	845 (29.6)	479 (33.4)	
75–79	1164 (16.5)	1561 (20.9)	626 (17.2)		5615 (17.7)	726 (25.4)	310 (21.6)	
⩾80	709 (10.0)	887 (11.9)	294 (8.1)		3430 (10.8)	601 (21.1)	180 (12.6)	
Education				<0.001				<0.001
Secondary or above	2686 (38.0)	1998 (26.8)	809 (22.3)		3239 (10.2)	156 (5.5)	92 (6.4)	
Primary	3377 (47.8)	4053 (54.4)	1988 (54.7)		9358 (29.5)	786 (27.5)	370 (25.8)	
No formal education but can read and write	565 (8.0)	840 (11.3)	470 (12.9)		6301 (19.8)	657 (23)	304 (21.2)	
Illiterate	444 (6.3)	564 (7.6)	389 (10.2)		12869 (40.5)	1254 (44)	666 (46.5)	
Ever alcoholic	2175 (30.8)	4667 (62.6)	2119 (58.3)	<0.001	3747 (11.8)	1038 (36.4)	420 (29.3)	<0.001
Regular exercise	6064 (85.8)	6344 (85.1)	2696 (74.2)	<0.001	27346 (86.1)	2427 (85.1)	1066 (74.4)	<0.001
Active chronic diseases								
Hypertension	2655 (37.5)	2683 (36.0)	920 (25.3)	<0.001	11995 (37.6)	1050 (36.8)	347 (24.2)	<0.001
Diabetes mellitus	928 (13.1)	966 (13.0)	341 (9.4)	<0.001	4078 (12.8)	367 (12.9)	127 (8.9)	<0.001
Heart disease	810 (11.5)	1045 (14.0)	299 (8.2)	<0.001	4156 (13.1)	442 (15.5)	150 (10.5)	<0.001
COPD/asthma	272 (3.8)	842 (11.3)	370 (10.2)	<0.001	1147 (3.6)	362 (12.7)	134 (9.4)	<0.001
Hypercholesterolaemia	892 (12.6)	925 (12.4)	313 (8.6)	<0.001	5763 (18.1)	520 (18.2)	162 (11.3)	<0.001
Cerebrovascular accident	243 (3.4)	364 (4.9)	116 (3.2)	<0.001	866 (2.7)	88 (3.1)	38 (2.7)	0.520
Medication taken regularly	3776 (53.4)	4287 (57.5)	1529 (42.1)	<0.001	17228 (54.2)	1676 (58.7)	613 (42.8)	<0.001
Any admission to hospital in the last year	895 (12.7)	1240 (16.6)	451 (12.4)	<0.001	3965 (12.5)	482 (16.9)	156 (10.9)	<0.001
Unintentional weight loss ⩾10 lb during the past 6 months	170 (2.4)	246 (3.3)	120 (3.3)	0.001	747 (2.4)	110 (3.9)	51 (3.6)	<0.001
Monthly personal expenditure (US$1 = HK$7.814)				<0.001				<0.001
<HK$1000 (£65, €96)	834 (11.8)	972 (13.0)	378 (10.4)		5357 (16.9)	509 (17.8)	282 (19.7)	
HK$1000–1999 (£65–130, €96–192)	2549 (36.0)	2778 (37.3)	1288 (35.4)		12648 (39.8)	1026 (36.0)	505 (35.3)	
HK$⩾2000 (£130, €192)	3689 (52.2)	3705 (49.7)	1969 (54.2)		13759 (43.3)	1318 (46.2)	645 (45.0)	
Regular contact with relatives	6869 (97.1)	7204 (96.6)	3466 (95.4)	<0.001	30979 (97.5)	2726 (95.5)	1379 (96.3)	<0.001
BMI category (kg/m^2)				<0.001				<0.001
<18.5 (underweight)	325 (4.6)	391 (5.3)	345 (9.5)		1438 (4.5)	240 (8.4)	222 (15.5)	
18.5–22.9 (normal weight)	2178 (30.9)	2371 (31.9)	1526 (42.0)		9635 (30.4)	904 (31.8)	529 (36.9)	
23.0–24.9 (at risk of obesity)	1782 (25.2)	1819 (24.5)	733 (20.2)		6971 (22.0)	573 (20.1)	265 (18.5)	
25.0–29.9 (obesity I)	2480 (35.1)	2556 (34.4)	920 (25.3)		11219 (35.4)	947 (33.3)	343 (24.0)	
⩾30.0 (obesity II)	293 (4.2)	300 (4)	108 (3.0)		2425 (7.7)	180 (6.3)	73 (5.1)	
Self-rated health				<0.001				<0.001
Better	2113 (29.9)	2201 (29.5)	1087 (29.9)		6498 (20.5)	664 (23.3)	303 (21.2)	
Normal	4637 (65.6)	4811 (64.5)	2322 (63.9)		22444 (70.7)	1876 (65.8)	1006 (70.3)	
Worse	321 (4.5)	443 (5.9)	226 (6.2)		2822 (8.9)	313 (11.0)	123 (8.6)	
Functional disability	318 (4.5)	473 (6.3)	178 (4.9)	<0.001	2675 (8.4)	367 (12.9)	121 (8.4)	<0.001
Depressive symptoms	260 (3.7)	370 (5.0)	256 (7.0)	<0.001	2366 (7.5)	309 (10.9)	164 (11.5)	<0.001

BMI, body mass index; COPD, chronic obstructive pulmonary disease.
Subjects with missing data were excluded.

to follow-up. By the end of 2003, 50 332 were still alive and 3884 deaths had occurred, 3829 of known causes and 55 of unknown causes. In addition to the 1951 subjects lost to follow-up, 2 subjects without a smoking status were also excluded, leaving 54 214 older people and 3883 deaths (1848 men and 2035 women) for analysis. Causes of death obtained for 3829 subjects were routinely coded by the governmental Department of Health according to the *International classification of diseases*—9th revision before 2001 and 10th revision in and after 2001.

Statistical analysis

A Cox proportional hazards model was used to estimate the relative risks (RRs, or hazard ratio) and the 95% CIs of all-cause and cause-specific mortality by smoking status (never smoker as the reference group), with adjustment for potential baseline confounders. The proportional hazards assumption was checked by visual inspection of plots of log (−log (S)) against time, where S was the estimated survival function. For cause-specific mortality analyses, subjects who died of other causes or unknown causes were regarded as censored at the date of death.[18 19] The population-attributable risk percentage (for all the study subjects) for all-cause mortality was based on the formula (Pe (RR−1)/1+Pe (RR−1)), where Pe was the prevalence of ever smoking and RR the adjusted RR for all-cause mortality. All statistical analyses were performed using SPSS V.13.0. Ethical approval was obtained from the ethics committee of the Li Ka Shing Faculty of Medicine, The University of Hong Kong, Pokfulam, Hong Kong. The study complied with the principles of the Declaration of Helsinki.

Table 2 Crude mortality (per 100 000 person-years) of 54 214 clients in Elderly Health Centres in Hong Kong by sex and smoking status

					Current smoker (cigarettes per day)							
	Never smoker		Former smoker		All current smoker		1–9*		10–20*		>20*	
Cause of death	n	Mortality	n	Mortality	n	Mortality	n	Mortality	n	Mortality	n	Mortality
Men												
Subjects	7072		7455		3635		1391		1547		564	
Person-years	29136		29856		14299		5557		6126		2018	
Malignant neoplasm												
Lung cancer	31	106	112	375	116	811	42	756	54	882	18	892
All cancers	179	614	321	1075	241	1685	92	1656	109	1779	34	1685
Cardiovascular disease												
Ischaemic heart disease	67	230	83	278	40	280	15	270	19	310	6	297
Stroke	42	144	71	238	40	280	17	306	17	278	4	198
All cardiovascular disease	143	491	218	730	103	720	43	774	46	751	12	595
Respiratory disease												
COPD	24	82	95	318	30	210	17	306	7	114	6	297
All respiratory diseases†	80	275	192	643	61	427	30	540	20	326	10	496
All causes	508	1744	869	2911	471	3294	202	3635	193	3151	66	3271
Women												
Subjects	31767		2853		1432		892		374		78	
Person-years	133270		11804		5910		3703		1513		298	
Malignant neoplasm												
Lung cancer	162	122	52	441	29	491	21	567	6	396	0	0
All cancers	615	461	101	856	52	880	35	945	13	859	0	0
Cardiovascular disease												
Ischaemic heart disease	181	136	29	246	13	220	6	162	4	264	2	671
Stroke	183	137	32	271	13	220	8	216	2	132	2	671
All cardiovascular disease	484	363	81	686	33	558	20	540	6	396	4	1343
Respiratory disease												
COPD	35	26	38	322	9	152	5	135	1	66	1	336
All respiratory diseases†	171	128	64	542	16	271	10	270	3	198	1	336
All causes	1622	1217	299	2533	114	1929	75	2025	24	1586	5	1678

COPD, chronic obstructive pulmonary disease.
*Subjects with missing data on cigarette consumption daily were excluded.
†Includes COPD, respiratory tuberculosis and other respiratory diseases.

RESULTS

Characteristics of subjects at baseline

We compared (a) the baseline data of age, education and smoking patterns in our cohort with the census and general population data, and (b) the proportionate mortality of major causes of deaths in our cohort with the Hong Kong Death Registry population data. More women than men enrolled in the study; however, for each sex the Cohen effect sizes[20] were small,[17] suggesting that even if our cohort, made up of volunteers, might be more health conscious, it should be reasonably representative of the general population of the same age in terms of basic demographic characteristics and mortality outcomes. The mean (SD) age of 18 162 men and 36 052 women at baseline were 72.8 (5.4) and 73.1 (5.8) years. There were more male than female current smokers (20.0% vs 4.0%) and former smokers (41.0% vs 7.9%; $p<0.001$). Table 1 shows that there were more current smokers than never smokers who drank alcohol, did not exercise regularly, had unintentional weight loss in the past 6 months, rated their health as worse, had depressive symptoms and had lower body mass index in both sexes.

Mortality by smoking status

Table 2 shows that in men and women, the mortality in former and current-smokers was higher than that in never smokers. Table 3 shows that in men, after adjusting for potential baseline confounders, current smokers and former smokers had significantly higher risks of death from lung cancer than never smokers (RR 6.66, 95% CI 4.41 to 10.06; RR 3.30, 95% CI 2.19 to 4.98), all cancers (RR 2.52, 95% CI 2.05 to 3.10; RR 1.65, 95% CI 1.36 to 2.00) and all causes (RR 1.75, 95% CI 1.53 to 2.00; RR 1.39, 95% CI 1.23 to 1.56). Current smokers also had a significantly higher risk of death from stroke than never smokers (RR 2.07, 95% CI 1.30 to 3.29) and all CVDs (RR 1.54, 95% CI 1.18 to 2.02), but former smokers did not. Former smokers showed higher risks of death from COPD than never smokers (RR 1.72, 95% CI 1.06 to 2.80) and all respiratory diseases (RR 1.39, 95% CI 1.04 to 1.87), but current smokers did not. Significant positive linear trends were also found between increasing smoking status (from never smokers, former smokers and current smokers who consumed 1–9, 10–20 and >20 cigarettes daily) and risks of death from lung cancer, all cancers, stroke, all CVDs and all causes. Similar results were also found in women.

Table 3 Adjusted RR with 95% CI for all-cause and cause-specific death by smoking status of clients in Elderly Health Centres in Hong Kong

				Cigarette consumption per day for current smoker					
	Never smoker	Former smoker	All current smoker	1–9	10–20	>20	Linear test for trend 1†	Linear test for trend 2‡	Ever smoker§
Cause of deaths	RR	RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)	p Value	p Value	RR (95% CI)
Men¶									
Malignant neoplasm									
Lung cancer	1.00	3.30*** (2.19 to 4.98)	6.66*** (4.41 to 10.06)	6.07*** (3.77 to 9.77)	7.40*** (4.67 to 11.73)	7.52*** (4.13 to 13.70)	<0.001	<0.001	4.42*** (3.00 to 6.51)
All cancers	1.00	1.65*** (1.36 to 2.00)	2.52*** (2.05 to 3.10)	2.34*** (1.81 to 3.04)	2.77*** (2.15 to 3.56)	2.58*** (1.76 to 3.78)	<0.001	<0.001	1.93*** (1.61 to 2.31)
Cardiovascular disease									
CHD	1.00	0.89 (0.63 to 1.27)	1.20 (0.79 to 1.83)	1.10 (0.62 to 1.96)	1.38 (0.81 to 2.37)	1.47 (0.62 to 3.47)	0.51	0.19	0.98 (0.71 to 1.36)
Stroke	1.00	1.33 (0.88 to 2.02)	2.07** (1.30 to 3.29)	1.98* (1.10 to 3.55)	2.26** (1.25 to 4.09)	1.65 (0.58 to 4.73)	0.002	0.005	1.55* (1.05 to 2.28)
All	1.00	1.20 (0.95 to 1.50)	1.54** (1.18 to 2.02)	1.52* (1.07 to 2.16)	1.70** (1.20 to 2.41)	1.43 (0.78 to 2.62)	0.002	0.002	1.29* (1.04 to 1.60)
Respiratory disease									
COPD	1.00	1.72* (1.06 to 2.80)	1.19 (0.67 to 2.14)	1.53 (0.78 to 2.98)	0.67 (0.28 to 1.62)	2.24 (0.89 to 5.68)	0.68	0.94	1.56 (0.97 to 2.51)
All	1.00	1.39* (1.04 to 1.87)	1.12 (0.78 to 1.61)	1.21 (0.77 to 1.88)	0.93 (0.56 to 1.55)	1.52 (0.77 to 3.00)	0.47	0.68	1.31 (0.99 to 1.74)
All causes	1.00	1.39*** (1.23 to 1.56)	1.75*** (1.53 to 2.00)	1.75*** (1.47 to 2.07)	1.78*** (1.50 to 2.12)	1.87*** (1.44 to 2.45)	<0.001	<0.001	1.50*** (1.34 to 1.67)
Women¶									
Malignant neoplasm									
Lung cancer	1.00	2.74*** (1.95 to 3.83)	3.19*** (2.11 to 4.83)	3.44*** (2.14 to 5.52)	2.85* (1.25 to 6.51)	Undetermined	<0.001	<0.001	2.89*** (2.16 to 3.86)
All cancers	1.00	1.42** (1.14 to 1.78)	1.66** (1.24 to 2.23)	1.68** (1.18 to 2.38)	1.79* (1.03 to 3.12)	Undetermined	<0.001	<0.001	1.50*** (1.24 to 1.81)
Cardiovascular disease									
CHD	1.00	1.20 (0.79 to 1.83)	1.58 (0.89 to 2.81)	1.04 (0.46 to 2.38)	2.44 (0.90 to 6.64)	6.64* (1.62 to 27.17	0.096	0.029	1.30 (0.91 to 1.87)
Stroke	1.00	1.31 (0.87 to 1.99)	1.60 (0.90 to 2.86)	1.41 (0.69 to 2.91)	1.17 (0.29 to 4.74)	6.87** (1.68 to 28.06	0.054	0.033	1.39 (0.97 to 1.99)
All	1.00	1.28 (0.99 to 1.66)	1.56* (1.09 to 2.24)	1.36 (0.86 to 2.14)	1.37 (0.61 to 3.09)	5.07** (1.88 to 13.68	0.004	0.002	1.36** (1.09 to 1.70)
Respiratory disease									
COPD	1.00	3.84*** (2.26 to 6.51)	2.37* (1.07 to 5.24)	1.78 (0.66 to 4.82)	1.16 (0.15 to 8.83)	7.92 (1.00 to 62.75)	<0.001	0.002	3.41*** (2.06 to 5.63)
All respiratory diseases	1.00	2.07*** (1.48 to 2.88)	1.39 (0.80 to 2.41)	1.14 (0.57 to 2.29)	1.38 (0.43 to 4.37)	3.33 (0.46 to 24.24)	0.002	0.005	1.87*** (1.38 to 2.54)
All causes	1.00	1.43*** (1.25 to 1.64)	1.38** (1.14 to 1.68)	1.31* (1.04 to 1.67)	1.37 (0.91 to 2.05)	1.59 (0.66 to 3.85)	<0.001	<0.001	1.42*** (1.26 to 1.59)

CHD, coronary heart disease; COPD, chronic obstructive pulmonary disease.
*p<0.05, **p<0.01, ***p<0.001.
†Linear trend with increasing smoking status from never, former and current smokers.
‡Linear trend with increasing smoking status from never smoker, former smoker and current smoker who consumed 1–9, 10–20 and ⩾21 cigarettes daily.
§Combining current smoker and former smoker.
¶Adjusted for age, education, alcohol consumption, physical exercise and active chronic diseases: hypertension, diabetes mellitus, heart diseases, COPD/asthma, hypercholesterolaemia, cerebrovascular accident, regular medication, admission to hospital, monthly expenditure, regular contact with relatives, unintentional weight loss in the past 6 months, body mass index, self-rated health, functional disability and depressive symptoms.

Effects of quitting on mortality

For men, former smokers had significantly lower risks of death from lung cancer (RR 0.51, 95% CI 0.39 to 0.67), all cancers (RR 0.64, 95% CI 0.54 to 0.77), stroke (RR 0.63, 95% CI 0.41 to 0.95) and all causes (RR 0.81, 95% CI 0.72 to 0.91) than current smokers. For women, quitting also reduced risks of mortality from lung cancer, all cancers, ischaemic heart disease, stroke and all CVDs, although the differences were not significant (table 4). However, higher risks of death from COPD were found in former smokers in men and women.

Excluding those who died soon after their first enrolment

When the analyses were repeated after excluding 244 deaths within 6 months of their first enrolment to reduce the ''ill quitter effect'' or ''healthy smoker effect'', similar results were observed; but the risks of death from COPD (RR 1.43, 95% CI 0.97 to 2.12) and all respiratory diseases (RR 1.30, 95% CI 0.99 to 1.72) in former smokers became insignificant (tables 5 and 6).

Population-attributable risk percentage for all-cause mortality

Table 3 shows that male and female ever smokers (combining current and former smokers) had 50% and 42% higher risks of all-cause death, respectively. The population-attributable fractions for all-cause mortality were 23.4% (95% CI 22.8% to 24.0%) for men and 4.8% (95% CI 4.5% to 5.0%) for women.

DISCUSSION

Most prospective studies on smoking and mortality are on middle-aged subjects, and have clearly shown that smoking is associated with increased risks of all-cause mortality and cause-specific mortality from CVDs, cancer and respiratory diseases, including the American Cancer Society Cancer Prevention Study 2 data used to estimate deaths attributable to smoking in the US.[21] Far fewer studies have focused on older people, especially older women, and the results are inconsistent. Some found that the effects of smoking on mortality in elderly people were similar to those in middle-aged people,[22 23] but others showed no statistically or only marginally significantly

Table 4 Adjusted RR (95% CI) for all-cause mortality and cause-specific mortality for quitting from smoking (former smokers compared with current smokers) of clients in Elderly Health Centres in Hong Kong

Cause of death	Men† RR (95% CI)	Women† RR (95% CI)	Total‡ RR (95% CI)
Malignant neoplasm			
Lung cancer	0.51*** (0.39 to 0.67)	0.86 (0.53 to 1.41)	0.58*** (0.46 to 0.73)
All cancers	0.64*** (0.54 to 0.77)	0.89 (0.63 to 1.28)	0.69*** (0.59 to 0.80)
Cardiovascular disease			
Ischaemic heart disease	0.75 (0.50 to 1.12)	0.81 (0.40 to 1.63)	0.77 (0.54 to 1.09)
Stroke	0.63* (0.41 to 0.95)	0.68 (0.33 to 1.38)	0.67* (0.47 to 0.95)
All cardiovascular	0.78 (0.61 to 1.00)	0.8 (0.52 to 1.23)	0.79* (0.64 to 0.98)
Respiratory disease			
COPD	1.42 (0.91 to 2.22)	1.86 (0.85 to 4.07)	1.49* (1.02 to 2.18)
All respiratory	1.22 (0.90 to 1.66)	1.68 (0.91 to 3.08)	1.32* (1.01 to 1.73)
All causes	0.79*** (0.70 to 0.89)	1.04 (0.82 to 1.31)	0.84** (0.75 to 0.93)

*p<0.05, **p<0.01, ***p<0.001.
†Adjusted for age, education, alcohol consumption, physical exercise and active chronic diseases: hypertension, diabetes mellitus, heart disease, chronic obstructive pulmonary disease/asthma, hypercholesterolaemia, cerebrovascular accident, regular medication, admission to hospital, monthly personal expenditure, regular contact with relatives, unintentional weight loss in the past 6 months, body mass index, self-rated health, functional disability and depressive symptoms.
‡Adjusted for sex and the variables above.

increased risks of mortality.[10 24] The results for former smokers are more controversial. Some studies combined former smokers with current smokers, and few potentially confounding variables were adjusted for. Some studies suggest that even among elderly people, the effects of smoking on mortality may differ between younger-old and older-old people.[10 11] The questions above need to be clarified in Western countries and also in developing countries, where populations are ageing rapidly and smoking has become more popular, especially in China, in which 30% of the world's cigarettes are consumed.[25 26] In mainland China, only one prospective study reported the detrimental effect of smoking on mortality in 1268 retired men in Xi'an.[9] At present, the epidemic of smoking-related mortality in China is still in its early stages. Prospective evidence from Hong Kong, which is at a fairly advanced stage of an epidemic of tobacco deaths, can forewarn the growing epidemic in mainland China and Asia in the next few decades and support early intervention.

The present study consistently shows that both current and former smoking significantly increased the risks of all-cause death with dose–response relationships by daily cigarette consumption for both male and female older Chinese in Hong Kong. The RRs for current smokers were about 1.8 in men and 1.4 in women, which were slightly lower than those from Western countries, but higher than those previously reported from mainland China. LaCroix *et al*[10] and Paganini-Hill and Hsu[23] reported an RR of about 2.0 for older men in the US, whereas Vogt *et al*[11] reported an RR of about 1.7–2.2 for older women. The prospective study from Xi'an by Lam *et al*[9] revealed an RR of 1.5 for older men. However, the only previous Hong Kong elderly cohort study by Ho *et al*[15] did not find statistically significantly increased risks of all-cause death for both male and female current smokers, but the sample size (999 men and 1033 women) was small and the duration of follow-up (3 years) was short.

Our elderly former smokers also showed increased RRs of 1.4 for all-cause mortality in both sexes (p<0.001). LaCroix *et al*[10] found a similar RR of 1.5 in male quitters, but the RR was insignificant in women. Paganini-Hill and Hsu[23] found lower risks than ours, with significant RRs of 1.2 in both male and female former smokers. Although Lam *et al*[9] did not find a significantly higher risk of mortality in male former smokers in Xi'an, China, they found similar results for ever smokers aged ⩾70 years in a large case–control study in Hong Kong, with odds ratios of 1.4 in men and 1.7 in women.[14] It should be noted that the comparison of RRs of studies with different age distributions could be problematic if RR varies by age.

We found significantly higher risks for all cancers and lung cancer in current smokers and also in former smokers, while most other elderly cohort studies only found the risks in current smokers but not in former smokers.[9–11 15 22]

Although smoking can cause ischaemic heart disease and CVDs, whether and to what extent the effects extend to those who have survived to old age need to be further examined. The Framingham Heart Study, with 30 years of follow-up, reported that there was no significant relationship between cigarette smoking and the incidence of and mortality from ischaemic heart disease,[24 27] although the American Cancer Society Cancer Prevention Study 2 did find increased mortality from ischaemic heart disease in both younger and older smokers.[21] For men and women separately, we did not find any statistically significant association between smoking (both current smoking and former smoking) and mortality from ischaemic heart disease. But for female current smokers who consumed >20 cigarettes daily, we found a significantly increased risk, with a significant linear trend. Combining men and women, we found a significant linear trend between smoking and risk of mortality from ischaemic heart disease. If ischaemic heart disease tends to kill Chinese smokers at a younger age than other diseases, the excess risks from smoking in elderly Chinese people would be much lower because of a survivor effect.

Our male current smokers also showed a higher risk of death from stroke, which was consistent with studies from the West[2 21 28 29], whereas previous studies on Chinese did not find such a relationship.[5–7 9 14] This was also true for our female heavy smokers who smoked >20 cigarettes daily. We also found that only current smoking, but not former smoking, increased the risk of death from all CVDs for both men and women, with dose–response relationships. Further studies are needed in different countries on how interactions of smoking with different cultures and lifestyles affect stroke and heart disease in middle age and in old age.

Our finding of higher risks of mortality from COPD in former smokers than in current smokers is consistent with other

Table 5 Adjusted RR with 95% CI for all-cause and cause-specific death by smoking status of clients in Elderly Health Centres in Hong Kong after excluding 244 deaths, people who died within 6 months after their first enrolment

	Never smoker	Former smoker	All current smoker	Cigarette consumption per day for current smoker			Linear test for trend 1†	Linear test for trend 2‡	Ever smoker§
				1–9	10–20	>20			
Cause of deaths	**RR**	**RR (95% CI)**	**RR (95% CI)**	**RR (95% CI)**	**RR (95% CI)**	**RR (95% CI)**	**p Value**	**p Value**	**RR (95% CI)**
Men¶									
Malignant neoplasm									
Lung cancer	1.00	3.36*** (2.20 to 5.13)	6.65*** (4.34 to 10.18)	6.17*** (3.78 to 10.07)	7.35*** (4.56 to 11.83)	7.24*** (3.86 to 13.59)	<0.001	<0.001	4.45*** (2.98 to 6.64)
All cancers	1.00	1.65*** (1.35 to 2.01)	2.48*** (2.00 to 3.07)	2.35*** (1.79 to 3.07)	2.66*** (2.05 to 3.46)	2.57*** (1.72 to 3.83)	<0.001	<0.001	1.92*** (1.59 to 2.30)
Cardiovascular disease									
CHD	1.00	0.88 (0.62 to 1.27)	1.17 (0.75 to 1.80)	1.01 (0.55 to 1.86)	1.37 (0.79 to 2.38)	1.54 (0.65 to 3.66)	0.624	0.223	0.96 (0.69 to 1.35)
Stroke	1.00	1.59* (1.01 to 2.50)	2.56*** (1.56 to 4.22)	2.26* (1.20 to 4.24)	2.98** (1.61 to 5.54)	2.22 (0.76 to 6.48)	<0.001	<0.001	1.87** (1.22 to 2.85)
All	1.00	1.26 (0.99 to 1.60)	1.60** (1.20 to 2.12)	1.47* (1.01 to 2.14)	1.87** (1.31 to 2.68)	1.49 (0.79 to 2.80)	0.001	0.001	1.35** (1.08 to 1.70)
Respiratory disease									
COPD	1.00	1.78* (1.08 to 2.96)	1.24 (0.68 to 2.26)	1.53 (0.76 to 3.06)	0.73 (0.30 to 1.77)	2.41 (0.94 to 6.16)	0.629	0.832	1.61 (0.98 to 2.65)
All	1.00	1.38* (1.02 to 1.86)	1.12 (0.77 to 1.61)	1.16 (0.73 to 1.83)	0.95 (0.57 to 1.60)	1.59 (0.80 to 3.13)	0.495	0.633	1.30 (0.98 to 1.74)
All causes	1.00	1.40*** (1.24 to 1.58)	1.75*** (1.52 to 2.01)	1.74*** (1.46 to 2.07)	1.80*** (1.50 to 2.16)	1.86*** (1.41 to 2.45)	<0.001	<0.001	1.51*** (1.34 to 1.69)
Women¶									
Malignant neoplasm									
Lung cancer	1.00	2.77*** (1.95 to 3.92)	3.25*** (2.11 to 4.99)	3.40*** (2.07 to 5.59)	3.11** (1.36 to 7.12)	Undetermined	<0.001	<0.001	2.93*** (2.17 to 3.95)
All cancers	1.00	1.46** (1.16 to 1.84)	1.73*** (1.28 to 2.33)	1.69** (1.17 to 2.43)	1.98* (1.13 to 3.45)	Undetermined	<0.001	<0.001	1.54*** (1.27 to 1.88)
Cardiovascular disease									
CHD	1.00	1.30 (0.85 to 2.00)	1.47 (0.79 to 2.74)	0.95 (0.39 to 2.34)	2.00 (0.63 to 6.33)	7.30** (1.78 to 29.97)	0.112	0.043	1.35 (0.93 to 1.96)
Stroke	1.00	1.39 (0.91 to 2.12)	1.46 (0.78 to 2.73)	1.13 (0.50 to 2.60)	1.26 (0.31 to 5.13)	7.73** (1.89 to 31.66)	0.084	0.047	1.41 (0.97 to 2.05)
All	1.00	1.37* (1.05 to 1.78)	1.48* (1.01 to 2.18)	1.24 (0.76 to 2.04)	1.23 (0.51 to 2.99)	5.62** (2.08 to 15.16)	0.005	0.003	1.40** (1.11 to 1.76)
Respiratory disease									
COPD	1.00	3.72*** (2.14 to 6.45)	2.54* (1.14 to 5.66)	1.92 (0.70 to 5.23)	1.21 (0.16 to 9.20)	8.51* (1.07 to 67.83)	<0.001	0.002	3.37*** (2.00 to 5.66)
All	1.00	2.08*** (1.48 to 2.93)	1.42 (0.80 to 2.52)	1.36 (0.63 to 2.52)	1.01 (0.25 to 4.11)	3.58 (0.49 to 26.11)	0.002	0.008	1.89*** (1.38 to 2.60)
All causes	1.00	1.46*** (1.27 to 1.67)	1.37** (1.12 to 1.68)	1.28 (1.00 to 1.65)	1.36 (0.89 to 2.07)	1.74 (0.72 to 4.20)	<0.001	<0.001	1.43*** (1.27 to 1.62)

CHD, coronary heart disease; COPD, chronic obstructive pulmonary disease.
*p<0.05, **p<0.01, ***p<0.001.
†Linear trend with increasing smoking status from never to former and current smoker.
‡Linear trend with increasing smoking status from never smoker, former smoker and current smoker consuming 1–9, 10–20, and 21 cigarettes or more daily.
§Combining current smoker and former smoker.
¶Adjusted for age, education, alcohol consumption, physical exercise, active chronic diseases: hypertension, diabetes mellitus, heart diseases, COPD/asthma, hypercholesterolaemia, cerebrovascular accident, regular medication, admission to hospital, monthly expenditure, regular contact with relatives, unintentional weight loss in the past 6 months, body mass index, self-rated health, functional disability and depressive symptoms.

findings.[9 30] Female but not male current smokers also showed higher risks of death from COPD than never smokers, which was also consistent with studies from Lam *et al*[9] and Vogt *et al*.[11] Some authors explained this by either the healthy smoker effect or the ill quitter effect, or both, because older smokers were survivors with probably less serious disease and those susceptible to COPD would have died earlier.[9] To reduce bias due to reverse causality, we carried out further analyses after excluding those who had died soon after their first enrolment—that is, within 6 months—and the excess risks of death from COPD and all respiratory diseases in former smokers, compared with current smokers, became insignificant. Some have suggested that a reduction in the risk of mortality from COPD was observed only in those who had quit smoking for >10 years,[30] but we could not examine the effect of years of quitting as data were not available.

We found significant effects of quitting; male former smokers had lower risks of mortality from all causes, lung cancer, all cancers and stroke than current smokers. Similar patterns were also found in women, although the reduced risks were not statistically significant, probably because of the small number of deaths. In short, all the available evidence, including ours, has consistently shown substantial benefits of quitting smoking even in elderly people, confirming that quitting is not too late, even after the age of 65.

One limitation of our study is that the period of follow-up was relatively short, but the number of deaths was enough to test some important hypotheses. In China and other developing countries where knowledge about the hazards of smoking is low, there is a common misbelief that smoking among elderly people is not that harmful (which is apparently supported by lower RRs due to a survivor effect) and that quitting may cause more harm (possibly due to reverse causality), particularly for COPD, which is a more common cause of death in China than in the West.[8 9] Our results support the development of a strong smoking cessation policy. Volunteer bias is another possible

Table 6 Adjusted RR* (95% CI) for all-cause mortality and cause-specific mortality for quitting from smoking (former smokers compared with current smokers) of clients in Elderly Health Centres in Hong Kong after excluding 244 deaths, people who died within 6 months after the first enrolment

	Men†	Women†	Total‡
Cause of death	**RR (95% CI)**	**RR (95% CI)**	**RR (95% CI)**
Malignant neoplasm			
Lung cancer	0.52*** (0.39 to 0.69)	0.87 (0.53 to 1.45)	0.58*** (0.46 to 0.75)
All cancers	0.66*** (0.55 to 0.79)	0.91 (0.63 to 1.31)	0.70*** (0.59 to 0.82)
Cardiovascular disease			
Ischaemic heart disease	0.77 (0.50 to 1.17)	1.00 (0.48 to 2.11)	0.82 (0.57 to 1.18)
Stroke	0.61* (0.39 to 0.93)	0.80 (0.38 to 1.70)	0.68* (0.47 to 0.98)
All cardiovascular disease	0.79 (0.61 to 1.03)	0.91 (0.58 to 1.43)	0.82 (0.66 to 1.03)
Respiratory disease			
COPD	1.42 (0.90 to 2.24)	1.65 (0.74 to 3.69)	1.43 (0.97 to 2.12)
All respiratory	1.21 (0.88 to 1.66)	1.66 (0.88 to 3.12)	1.30 (0.99 to 1.72)
All causes	0.80*** (0.71 to 0.90)	1.08 (0.85 to 1.37)	0.85** (0.76 to 0.95)

*p<0.05, **p<0.01, ***p<0.001.
†Adjusted for age, education, alcohol consumption, physical exercise, active chronic diseases: hypertension, diabetes mellitus, heart disease, COPD/asthma, hypercholesterolaemia, cerebrovascular accident, regular medication, admission to hospital, monthly personal expenditure, regular contact with relatives, unintentional weight loss in the past 6 months, body mass index, self-rated health, functional disability and depressive symptoms.
‡Adjusted for sex and all variables above.

limitation as all the subjects were attendees at a primary care facility. The Elderly Health Centres tend to attract healthier clients who voluntarily come to the clinics, so the risks of smoking in the general elderly population in Hong Kong might be underestimated. As the Cohen effect sizes for baseline demographic characteristics and proportionate mortality were small, this bias should not be substantial.

Our study had several strengths. The mortality data are available from the death registry database, which is checked regularly by the Department of Health. Records were linked using the unique Hong Kong identification number. Almost all deaths in Hong Kong are certified by doctors in the hospital, and validity and completeness of the causes of death should be good, especially within the broad categorisation that we are using for the causes of death. Hong Kong Death Registry data have been used in many studies and have been found to be of good quality.[14] The sample size was large and we had a large number of current smokers and former smokers, especially women, which allowed us to conduct separate analyses for each sex and test the effect of quitting. The successful follow-up rate was higher and we adjusted for more potential confounders than previous studies.

In conclusion, the present study showed significantly higher risks of death from all causes, cancer, CVDs and respiratory diseases among current smokers and former smokers for both male and female older people in Hong Kong, and quitting smoking was beneficial in reducing these risks. Smoking cessation, including in elderly smokers, should be an urgent public health priority in Hong Kong and also in other developing countries, especially in mainland China and in other rapidly ageing populations in the East.

What this paper adds

- Smoking kills; however, the harms of smoking and the benefits of quitting are not well established in older Chinese.
- Older Chinese male and female smokers and ex smokers had higher risks of dying.
- Quitters had significantly lower risks of death than currents smokers.
- Smoking cessation is urgently needed in rapidly ageing populations in the East.

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