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The hazards and benefits associated with smoking and smoking cessation in Asia: a meta-analysis of prospective studies

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ABSTRACT

Objective: To provide the most reliable evidence as to the nature of the associations between smoking and cause-specific illness, as well as the expected benefits from quitting smoking, in studies conducted in Asia, where smoking remains popular among men.

Data sources: Studies published between January 1966 and October 2008, identified in the Medline search strategy with medical subject headings, in addition to studies from the Asia Pacific Cohort Studies Collaboration.

Study selection: Studies were considered to be relevant if they were prospective studies, in an Asian setting that reported on the association between smoking, quitting and cause-specific illness.

Data extraction: Two reviewers independently screened all identified articles for possible inclusion and extracted data.

Data synthesis: The pooled relative risks (RRs) for incidence or mortality, comparing current to never smokers were always significantly higher than unity; the highest was for lung cancer: 3.54 (95% confidence interval 3.00 to 4.17). The pooled RRs for former smokers (compared to never smokers) were also always significantly higher than unity, and were lower than in current smokers, for coronary heart disease, stroke, lung and upper aero-digestive tract cancer. Only for respiratory disease was the RR for former smokers higher than that for current smokers.

Conclusions: This meta-analysis has shown that, despite the relative immaturity of the smoking epidemic in Asia, smoking is unquestionably a major contributor to ill health and death. However, the beneficial effects of quitting are not yet always apparent, most probably because quitting is a consequence of ill health and the relative unpopularity of smoking cessation in many Asian populations.

The seminal work of Doll and Hill[1 2] in the 1950s convincingly demonstrated the causal role of smoking in lung cancer and prompted a sharp decline in the popularity of the habit, particularly in countries such as the United Kingdom and the United States.[3–5] Fifty years on, thanks largely to highly effective mass-media campaigns,[4 5] there is now widespread acceptance among most Western populations of the causal role of smoking in a plethora of diseases, such as many cancers, cardiovascular and respiratory diseases.[6 7] Combined with broad legislative measures and tobacco tax policies,[4 5] such campaigns have been instrumental in convincing hundreds of thousands of smokers to quit and dissuading thousands of others from taking up the habit.

Despite these enormous efforts to curb the smoking pandemic, it remains the second leading cause of death (after high blood pressure), accounting for 12% of all deaths worldwide, as well as one of the major causes of disability.[8 9] Paradoxically, most of these deaths occur in Western populations that now have some of the lowest smoking rates (typically less than 30% in men), whereas the burden of smoking-related illness in Asia (where between 50–60% of men smoke depending on the country[3–5 10]) remains disproportionately low.[11] This partly reflects the often long latency period between smoking and onset of illness, but over the coming decades this global pattern of morbidity and mortality is likely to reverse if current smoking trends in Asia persist. Moreover, the enormous public health burden that is the result of smoking will have a substantial negative impact on a country's economy, an effect that will be particularly great in Asian countries relative to the West over the coming decades.[4 12]

Although there are several countries in Asia where the prevalence of smoking among men has been on the decline in recent years, including Hong Kong, Thailand, Singapore and Japan,[3–5 10 13] in other countries such as China and Indonesia, there is no evidence to indicate a similar decline in the popularity of the habit. There are perhaps two main reasons for this, a low level of awareness as to the harms associated with the habit[7 14–16] and a lack of population-wide smoking cessation strategies. An essential prerequisite for any smoking cessation campaign is a sound evidence base. To this end, we conducted a systematic review of the literature for all Asian studies that reported on the association between smoking, quitting and illness in order to provide the most reliable evidence as to the nature of the associations between smoking and cause-specific illness, as well as the expected benefits of quitting smoking, in studies conducted in Asia.

METHODS

Search strategy

We performed a systematic search for relevant articles published from January 1966 to October 2008, using Medline. We searched with medical subject headings (MeSH): ([Smoking (MeSH)] *or* [Tobacco (MeSH)] *or* [Tobacco use cessation (MeSH)] *or* [Smoking cessation (MeSH)]) *and* ([Cardiovascular diseases (MeSH), including MeSH terms found below this term in the MeSH tree] *or* [Neoplasms (MeSH), including MeSH terms found below this term in the MeSH tree] *or* [Respiratory tract diseases (MeSH), including MeSH terms found below this term in the MeSH tree]) *and* ([Asia (MeSH), including MeSH terms found below this term in the MeSH tree]). We restricted the search to English language articles and studies of human subjects. We read the titles and abstracts of all the articles identified in the Medline search to exclude any articles that seemed irrelevant. The full texts of the remaining articles were read to determine if they met our criteria for inclusion. In addition, we manually searched for extra relevant articles in the reference lists of the identified articles and other publications.

Data extraction

Articles were considered to be relevant if they were prospective studies (cohort studies or nested case-control studies), in an Asian setting, that calculated the approximate relative risks (RRs) (that is, hazard ratios, rate ratios or odds ratios) for coronary heart disease (CHD), stroke, site-specific cancer and respiratory disease incidence and/or mortality in both current smokers and former smokers with never smokers serving as the referent. Articles were excluded if they did not provide the RR with 95% confidence interval in both current smokers and former smokers with adjustment at least for age. Articles were also excluded if the study population solely consisted of individuals with a particular high-risk condition (for example, high blood pressure or diabetes) or of hospital patients. In the case of multiple publications from the same or overlapping cohorts, we selected only the article with the largest person-years of follow-up or, if the articles had exactly the same person-years of follow-up, only the article with the most exhaustive level of adjustment for potential confounders.

The Asia Pacific Cohort Studies Collaboration (APCSC) is a collaboration of prospective studies in the Asia-Pacific region[17,18] that has previously published results on smoking, quitting and several diseases.[19,20] For the current work we included only Asian studies in APCSC that were not otherwise included in the search of published literature, to avoid duplication.

Statistical analysis

Outcomes treated in this article are CHD, stroke, cancer and respiratory diseases. Cancer was classified into four categories: lung cancer, upper aero-digestive tract (UADT) cancer, gastric cancer and other cancers. No other cancers, or subsets within our chosen classifications, provided large enough numbers of events for reliable estimation of associations. In most relevant articles, including APCSC, outcomes were defined using the International Classification of Diseases or the International Classification of Diseases for Oncology.

The primary analysis was to estimate pooled RRs for incidence (that is, fatal or non-fatal events) and mortality (that is, where fatal events alone were reported) combined for each of the seven diseases. Should an article report RRs for both incidence and mortality, only the RR for incidence was used for the primary analysis. As a secondary analysis, summary estimates were obtained for mortality only. Further analyses repeated the above for separate countries. Again, to avoid small numbers, and thus unreliable results, only China, Japan and Korea were separated, although we included a category of other Asian countries for completeness.

For current smokers and former smokers, pooled RRs and their corresponding 95% confidence intervals for the outcomes of interest were estimated using a random effects model with inverse variance weighting.[21] Statistical heterogeneity within studies was assessed using the Cochran's Q test for heterogeneity and Higgins's I^2 statistic.[21] I^2 is interpreted as the percentage of variability between studies due to heterogeneity, rather than chance, with 0% representing no heterogeneity. These meta-analyses were carried out using Stata, version 9.

RESULTS

Our search strategy identified a total of 2705 articles (fig 1), of which 60 were considered as relevant studies that met our criteria for inclusion. Seven additional relevant articles were identified from reference lists. Of these 67 relevant articles, 14 articles were excluded because of multiple publications. In addition, APCSC provided 24 additional cohort studies. In all, this gave 77 individual studies for inclusion in the meta-analysis: 73 cohort studies and four nested case-control studies.

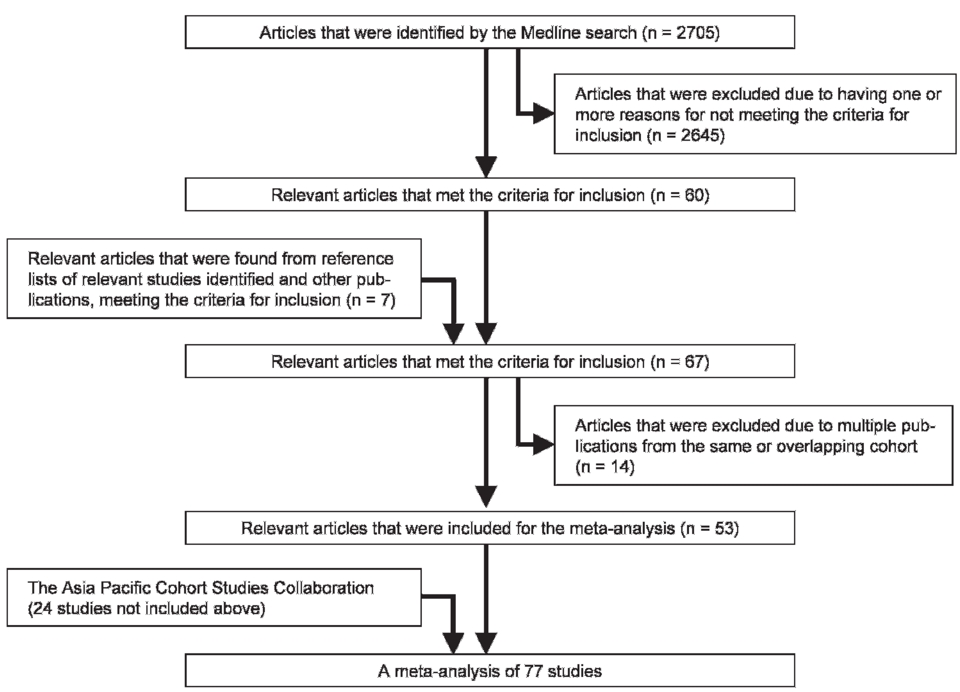

Figure 1 Flow chart of search strategy and data extraction.

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Table 1 Characteristics of the 53 published studies and the Asia Pacific Cohort Studies Collaboration involving 24 studies

First author/ publication year [ref]	Country	Initial year of survey	Participants (n)	Age range (years)	Current (%)	Quit (%)	Max FUP duration (years)	Study design	Outcomes		Events (n)	Adjustments
									Type	Disease		
Ross/1997[22]	China	1986	(M) 1470	45–64			7	Nested	Mor	Stroke	245	1, 3, 6, 7, 9, 10
Yuan/2001[23]	China	1986	(M) 831	45–64			11	Nested	Inci	Cancer (lung)	209	1, 10
Fan/2008[24]	China	1986	(M) 18 244	45–64	50	12	20	Cohort	Inci	Cancer (oesophageal)	101	1, 3, 4, 6, 10
Lam/2002[25]	China	1987	(M) 1267	60–	33	52	12	Cohort	Mor	Coronary heart disease	52	1, 3, 5, 6, 7, 8, 10
										Stroke	37	
										Cancer (lung)	40	
										Respiratoy diseases	43	
Astrakianakis/2007[26]	China	1989	(F) 3812	NA			10	Nested	Inci	Cancer (lung)	628	1
Kelly/2008[27]	China	1991	(M) 76 134	40–	59	6	10	Cohort	Inci	Stroke	3869	1, 3, 5, 6, 7, 9, 10
			(F) 78 997		13	5					2911	
									Mor	Stroke	2300	
											1679	
Qiao/1997[28]	China	1992	(M) 7867	40–	80	12	3	Cohort	Inci	Cancer (lung)	241	1
Qiu/2003[29]	China	1994	50 252	40–	40	7	6	Cohort	Mor	Stroke	627	1, 2, 3, 4, 6, 7, 10
Shibata/1990[30]	Japan	1960	(M) 642	40–69	76	11	28	Cohort	Mor	Cancer (liver)	22	1
Akiba/1994[31]	Japan	1963	61 505	NA	NA	NA	17	Cohort	Inci	Cancer (lung)	610	1, 2, 10
										Cancer (pharynx, oesophagus, nasal cavity)	198	
										Cancer (stomach)	1513	
										Cancer (colon, rectum, liver, gallbladder, pancreas, skin, breast, uterus, ovary, prostate, bladder, kidney, ureter, brain, thyroid, lymphoma, myeloma, leukaemia)	2705	
Kono/1985[32]	Japan	1965	(M) 5438	NA	68	21	12	Cohort	Mor	Coronary heart disease	121	1
										Stroke	154	
										Cancer (lung)	43	
										Cancer (upper aero-digestive)	17	
										Cancer (gastric)	79	
Kinjo/1999[33]	Japan	1965	223 170	40–69	NA	NA	16	Cohort	Mor	Stroke	11 030	1, 2, 10
Marugame/2005[34]	Japan	1983	(M) 44 451	40–79	58	30	10	Cohort	Mor	Cancer (lung)	598	1, 10
			(F) 43 702		12	24						
Koizumi/2004[35]	Japan	1984	(M) 29 392	40–	60	24	9	Cohort	Inci	Cancer (gastric)	451	1, 3, 4, 6, 10
Kato/1992[36]	Japan	1985	9753	30–	NA	NA	5	Cohort	Mor	Cancer (stomach)	57	1, 2, 3, 4, 10
Mizoue/2000[37]	Japan	1986	(M) 4050	40–	50	38	9	Cohort	Mor	Cancer (lung)	42	1, 3, 10
										Cancer (stomach)	53	
										Cancer (liver)	59	
Pham/2007[38]	Japan	1986	(M) <4254	40–	NA	NA	17	Cohort	Mor	Stroke	192	1, 2, 3, 4, 6, 7, 9, 10
			(F) <5397									
Pham/2007[39]	Japan	1986	(M) 3996	40–	49	38	17	Cohort	Mor	Cancer (lung)	NA	1, 3, 4, 6, 7, 9, 10
			(F) 4133		8	33				Respiratory disease	231	
Iso/2005[40]	Japan	1988	(M) 41 782	40–79	54	32	11	Cohort	Mor	Coronary heart disease	547	1, 3, 4, 5, 6, 7, 9, 10
			(F) 52 901		6	23				Stroke	1248	
Ando/2003[41]	Japan	1988	(M) 45 010	40–79	53	33	9	Cohort	Mor	Cancer (lung)	597	1
			(F) 55 726		6	24						
Sakata/2005[42]	Japan	1988	(M) 42 578	40–79	53	33	11	Cohort	Mor	Cancer (oesophageal)	100	1, 10
Fujino/2005[43]	Japan	1988	(M) 43 482	40–79	53	33	11	Cohort	Mor	Cancer (stomach)	757	1, 3, 4, 10
			(F) 54 580		NA	NA						
Wakai/2003[44]	Japan	1988	(M) 25 260	40–79	52	34	9	Cohort	Inci	Cancer (colon, rectal)	612	1, 3, 4, 5, 6, 10
			(F) 34 619		5	24						
Fujita/2006[45]	Japan	1988	2595	40–79			11	Nested	Mor	Cancer (hepatocellular)	29	1, 2, 3, 9, 10

Continued

Table 1 Continued

First author/ publication year [ref]	Country	Initial year of survey	Participants (n)	Age range (years)	Current (%)	Quit (%)	Max FUP duration (years)	Study design	Outcomes Type	Outcomes Disease	Events (n)	Adjustments
Yagyu/2008[46]	Japan	1988	(M) <47 756	40–89	53	34	15	Cohort	Mor	Cancer (gallbladder)	66	1, 3, 10
			(F) <65 740		6	24					74	
Lin/2002[47]	Japan	1988	(M) 44 646	40–79	57	33	9	Cohort	Mor	Cancer (pancreatic)	225	1, 6, 9, 10
			(F) 54 881		9	31						
Washio/2005[48]	Japan	1988	114 517	40–	NA	NA	11	Cohort	Mor	Cancer (kidney)	44	1, 2
Niwa/2005[49]	Japan	1988	(F) 34 639	40–79	5	24	11	Cohort	Inci	Cancer (ovarian)	39	1, 3, 6, 10
Lin/2008[50]	Japan	1988	(F) 34 401	40–79	5	24	13	Cohort	Inci	Cancer (breast)	208	1, 3, 5, 6, 10
Ide/2008[51]	Japan	1988	(M) 34 136	40–79	53	33	NA	Cohort	Mor	Cancer (oral, pharyngeal)	41	1, 3, 4
Baba/2006[52]	Japan	1990	(M) 19 782	40–59	53	30	12	Cohort	Inci	Coronary heart disease	326	1, 3, 4, 7, 8, 9, 10
			(F) 21 500		6	23						
Mannami/2004[53]	Japan	1990	(M) 19 782	40–59	53	30	12	Cohort	Inci	Stroke	1149	1, 3, 4, 5, 6, 9, 10
			(F) 21 500		6	23						
Sobue/2002[54]	Japan	1990	(M) 44 533	40–69	52	31	10	Cohort	Inci	Cancer (lung)	332	1, 10
			(F) 48 281		6	19						
Sasazuki/2002[55]	Japan	1990	(M) 19 576	40–59	53	30	10	Cohort	Inci	Cancer (gastric)	273	1, 3, 4, 6, 10
Otani/2003[56]	Japan	1990	(M) 42 540	40–69	52	31	10	Cohort	Inci	Cancer (colorectal)	706	1, 3, 5, 6, 10
			(F) 47 464		6	19						
Luo/2007[57]	Japan	1990	(M) 47 499	40–69	52	32	14	Cohort	Inci	Cancer (pancreatic)	224	1, 3, 5, 6, 9, 10
			(F) 52 171		6	20						
Hanaoka/2005[58]	Japan	1990	(F) 21 781	40–59	6	23	10	Cohort	Inci	Cancer (breast)	180	1, 3, 6, 10
Nishino/2004[59]	Japan	1990	(M) 21 695	40–64	62	24	7	Cohort	Inci	Cancer (lung)	129	1, 3, 4, 5, 10
Akhter/2007[60]	Japan	1990	(M) 21 199	40–64	NA	NA	10	Cohort	Inci	Cancer (colorectal)	307	1
Fujisawa/2008[61]	Japan	1998	(M) 275	80	23	67	4	Cohort	Mor	Respiratory illness	21	(1) 6, 7, 8, 9, 10
Jee/1999[62]	Korea	1990	(M) 106 745	35–59	58	27	6	Cohort	Inci	Ischemic heart disease	1006	1, 7, 8, 9
										Cerebrovascular disease	1364	
Jee/2004[63]	Korea	1992	(M) 830 139	30–95	57	29	9	Cohort	Inci	Cancer (lung)	4445	1
			(F) 382 767		5	32				Cancer (oesophageal, larynx)	1344	
										Cancer (stomach)	7316	
										Cancer (colon, liver, bile duct, pancreatic, prostate, kidney, bladder, brain, thyroid, leukaemia)	11 915	
									Mor	Cancer (lung)	4238	
										Cancer (oesophageal, larynx)	834	
										Cancer (stomach)	4508	
										Cancer (colon, liver, bile duct, pancreatic, prostate, kidney, bladder, brain, thyroid, leukaemia, breast)	8123	
Odongua/2007[64]	Korea	1992	(F) 475 398	30–95	4	33	12	Cohort	Inci	Cancer (cervical)	2523	1, 3, 6, 10
									Mor	Cancer (cervical)	209	
Jee/2007[65]	Korea	1993	(F) 134 399	40–69	10	30	10	Cohort	Inci	Ischaemic heart disease	4534	1, 3, 7, 8, 9
										Cerebrovascular disease	7961	
Ho/1999[66]	Hong Kong	1991	(M) 999	70–	25	64	3	Cohort	Mor	Respiratory diseases	157	1, 3, 6, 7, 10
			(F) 1033		8	69						
Lam/2007[67]	Hong Kong	1998	(M) 18 162	65–	20	67	5	Cohort	Mor	Coronary heart disease	413	1, 3, 5, 6, 7, 8, 9, 10
			(F) 36 052		4	67				Stroke	381	
										Cancer (lung)	502	
										Respiratory diseases	584	
Jayalekshmy/2008[68]	India	1990	(M) 65 829	30–84	48	19	8	Cohort	Inci	Cancer (lung)	203	1, 10

Continued

Table 1 Continued

First author/ publication year [ref]	Country	Initial year of survey	Participants (n)	Age range (years)	Current (%)	Quit (%)	Max FUP duration (years)	Study design	Outcomes		Events (n)	Adjustments
									Type	Disease		
Yuan/2003[69]	Singapore	1993	62 392	45–74	20	36	7	Cohort	Inci	Cancer (lung)	482	1, 2, 10
Tsong/2007[70]	Singapore	1993	63 257	45–74	19	36	10	Cohort	Inci	Cancer (colon, rectal)	845	1, 2, 3, 5, 6, 9, 10
Friborg/2007[71]	Singapore	1993	61 320	45–74	20	36	12	Cohort	Inci	Cancer (nasopharyngeal, other oropharyngeal)	248	1, 2, 3, 4, 10
Chen/2004[71]	Taiwan	1985	10 589	NA	27	28	16	Cohort	Inci	Cancer (lung)	138	1, 2, 3, 10
Hsu/2004[73]	Taiwan	1989	4048	60–	35	31	7	Cohort	Inci	Heart disease	NA	1, 2, 10
										Stroke	NA	
										Lower respiratory tract disease	NA	
Wen/2005[74]	Taiwan	1989	(M) 30 244	35–	29	32	12	Cohort	Mor	Ischaemic heart disease	NA	1
										Cerebrovascular disease	NA	
										Cancer (lung)	NA	
										Cancer (stomach)	NA	
										Cancer (liver)	NA	
										Respiratory diseases	NA	
Asia Pacific	China	1960s–	(M) 175 906	20–	59	7	3–25	Cohort	Mor	Coronary heart disease	775	1, 2
Cohort Studies	Japan	1990s	(F) 77 058		5	19				Stroke	1519	
Collaboration (24 studies)	Hong Kong Taiwan Singapore Thailand									Cancer (lung)	843	

The rate of current smokers was defined as the number of current smokers among total participants. The rate of quitters was defined as the number of former smokers among ever smokers. The rate of current smokers and quitters were not presented for nested case-control studies.
Adjustments: 1, age; 2, sex; 3, alcohol; 4, diet; 5, exercise (or walking); 6, body mass index; 7, hypertension (or blood pressure); 8, dyslipidaemia (or serum cholesterol, triglycerides); 9, diabetes (or blood sugar); 10, others.
For the Asia Pacific Cohort Studies Collaboration, the initial year of baseline survey and the maximum duration of follow-up varied by participating study.
Current, current smokers; F, female; Inci, incidence; M, male; Max FUP, maximum duration of follow-up; Mor, mortality; NA, not available; Quit, quitters.

The characteristics of these studies are summarised in table 1, according to country and initial year of baseline survey.[22–74] Of the 77 studies, 42 studies were from Japan; 16 from China, five from Singapore, five from Taiwan, four from Korea, three from Hong Kong, one from India and one from Thailand. In most studies, the prevalence of current smoking among men was over 50%, whereas for women it was typically below 10%. In the 1990s, China had a higher rate of current smokers (defined as the number of current smokers among total participants) and a lower rate of quitters (defined as the number of former smokers among ever smokers) among men, compared to Japan and Korea.

The pooled RRs for incidence or mortality, comparing current to never smokers were always significantly higher than unity, ranging from a value of 1.23 for other cancers to 3.54 for lung cancer (fig 2). The pooled RRs for former smokers (compared to never smokers) were also always significantly higher than unity, but were lower than in current smokers for CHD, stroke, lung cancer and UADT cancer, although not always significantly so. Former smokers had much the same risk as never smokers for gastric and other cancers and for respiratory diseases. The pooled RRs for mortality presented a similar pattern to the pooled RRs for incidence and mortality combined (data not shown). There was a high degree of heterogeneity in the estimates between studies for all except other cancers and respiratory diseases. With these two exceptions, I^2 statistics ranged from 32% to 89% and all Q tests were significant at the 10% level. This justifies the use of random effects methodology.

In a sensitivity analysis in which the four nested case-control studies were excluded, including one stroke study, two lung cancer studies and one liver cancer study, the pooled RR (95% confidence interval) for current smokers and former smokers (compared to never smokers) was 1.36 (1.23 to 1.50) and 1.10 (1.01 to 1.21) for stroke, 3.48 (2.95 to 4.10) and 2.11 (1.86 to 2.04) for lung cancer and 1.23 (1.13 to 1.34) and 1.22 (1.16 to 1.24) for other cancers, respectively. These results were broadly similar to those shown in figure 2, indicating that these studies did not bias the overall summary estimates.

In country-specific analyses, the pooled RRs (compared to never smokers) from studies conducted in Japan and Korea tended to be lower in former smokers than in current smokers for CHD, stroke, lung cancer, UADT cancer and respiratory diseases (table 2). However, former smokers had higher pooled RRs compared with current smokers for respiratory diseases in China and for stroke and respiratory diseases in other Asian countries, although the pooled RRs for CHD, stroke (in China), lung cancer and UADT cancer were lower in former, than current, smokers (table 2).

DISCUSSION

In the present study, we have provided the most reliable estimates to date as to the health hazards of smoking and the benefits of quitting for various diseases in Asian populations. Our summary estimates indicate that smoking is certainly hazardous for cardiovascular diseases (especially CHD), cancer

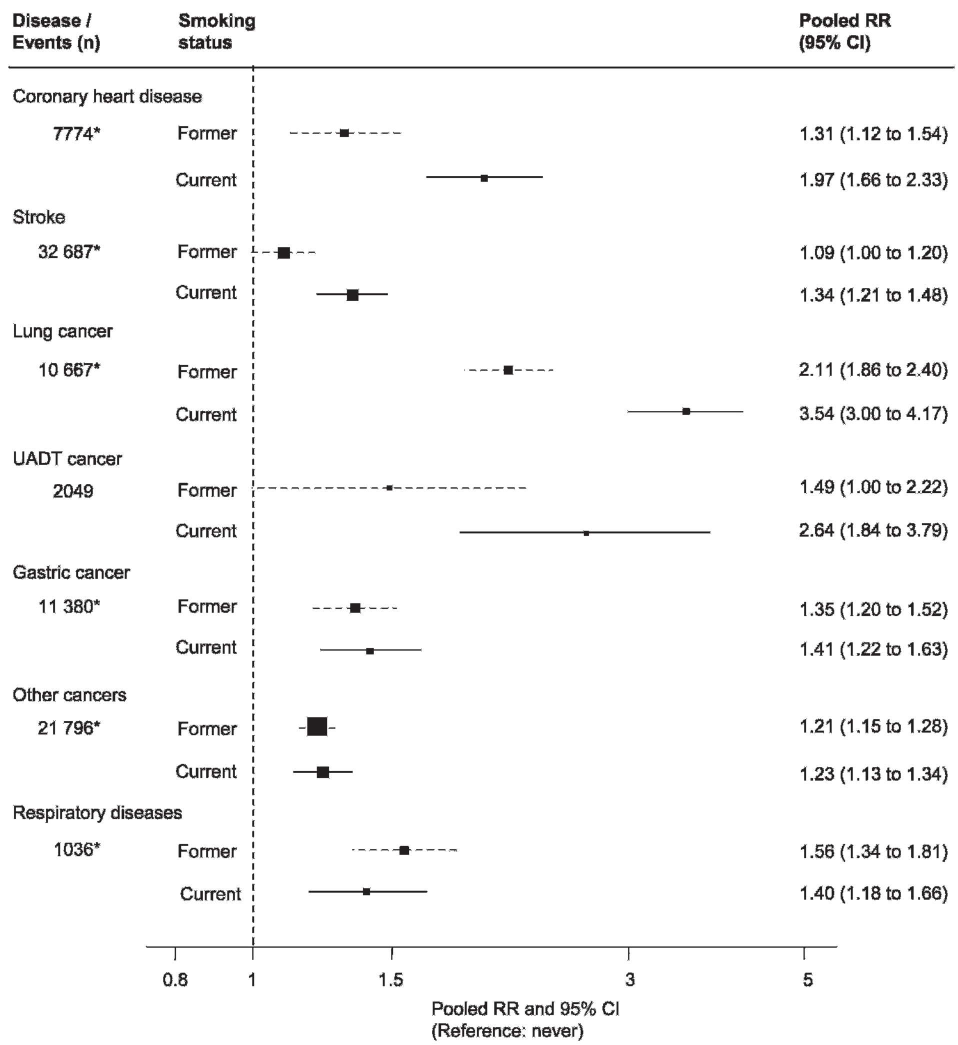

Figure 2 Pooled relative risks (RRs) and 95% confidence intervals (CIs) for incidence and mortality combined in former smokers (broken lines) and current smokers (solid lines) with never smokers serving as the referent. Upper aero-digestive tract (UADT) cancer included oesophageal, oral, nasopharyngeal and laryngeal cancer. Other cancers included colon, rectum, liver, gallbladder, pancreas, skin, breast, uterus, ovary, prostate, bladder, kidney, ureter, brain, thyroid cancer, lymphoma, multiple myeloma and leukaemia. Asterisks indicate that one or two studies did not report the number of events.

(especially lung cancer and UADT cancer) and respiratory diseases in Asia. Importantly, in most instances, we were able to show that quitting smoking reverses the harmful effects of smoking on most diseases that are closely associated with smoking, except that we were unable to show these benefits completely for China. One explanation of why the beneficial effects of quitting smoking were not wholly apparent in Chinese studies may have been because of the underlying presence of disease in smokers who had reportedly quit smoking. In support of this, there is some evidence to suggest that the reasons for quitting smoking differ considerably between developed and developing countries. In the former, smokers are more likely to quit for health reasons,[75] whereas in developing countries, where the hazards of smoking are much less widely known, the primary reason for quitting is ill health.[15] Consequently, the beneficial effects of smoking cessation are likely to be underestimated among such individuals.[20 76 77]

Our overall summary estimates are specific to Asian populations (who have many different physiological and non-physiological characteristics from Western populations), but even among these studies, there was evidence of significant heterogeneity of the impact of smoking and smoking cessation on health outcomes. This may be because of the differences in smoking behaviour and/or genetic, environmental or lifestyle-related factors between countries; although the differences in factors related to research methodology (for example, range of age, method for identification of the events, levels of adjustment) between studies may also have played a part. For instance, in a study where smokers have a high average consumption of cigarettes per smoker the health hazard of smoking will be proportionally large. On the other hand, extensive passive exposure to environmental tobacco smoke either at home or in the workplace may have resulted in an underestimation of the true harms of smoking, owing to the classification of such individuals as "never smokers" in most studies (thereby ignoring their exposure to environmental tobacco smoke).[78] Other environmental air pollutants (for example, indoor coal burning), which is also a major health concern associated as it is with mortality and disability in developing regions,[8 79] may also attenuate the risk for lung cancer, UADT cancer and respiratory diseases attributed to smoking.[79–82]

The present study suggests that the health hazards of smoking for CHD, stroke, lung cancer and UADT cancer have been underestimated in China, where tobacco control is particularly crucial, given that China has approximately 20% of the world's population and the Chinese consume about one-third of cigarettes smoked in the world.[4 5] This underestimation could, in part, be due to the potentially extreme passive exposure to cigarette and/or other environmental air pollution in China.[4 79–83] It may well have led to a lack of awareness of the harmful effects of smoking among the Chinese; about three-quarters of smokers and two-thirds of non-smokers in China regard smoking as confering

Table 2 Pooled relative risks for incidence and mortality combined in former smokers and current smokers with never smokers serving as the referent group by country

Disease	Smoking status	Pooled relative risk (95% CI) (reference: never)			
		China	Japan	Korea	Other Asia
Coronary heart disease					
		Events: 421	Events: 1205	Events: 5540	Events: 608*
	Former	1.25 (0.83 to 1.86)	1.51 (1.20 to 1.90)	1.57 (0.91 to 2.71)	1.12 (0.94 to 1.33)
	Current	1.68 (1.03 to 2.74)	2.60 (2.19 to 3.09)	1.90 (1.48 to 2.44)	1.47 (1.13 to 1.91)
Stroke					
		Events: 8479	Events: 14 343	Events: 9325	Events: 540*
	Former	1.08 (0.86 to 1.36)	1.03 (0.89 to 1.18)	1.10 (1.01 to 1.19)	1.40 (1.15 to 1.71)
	Current	1.25 (1.18 to 1.31)	1.39 (1.20 to 1.62)	1.60 (1.55 to 1.65)	1.36 (0.99 to 1.85)
Lung cancer					
		Events: 1729	Events: 2497*	Events: 5030	Events: 1411*
	Former	1.96 (1.38 to 2.79)	2.09 (1.73 to 2.53)	1.94 (1.69 to 2.23)	2.42 (1.82 to 3.22)
	Current	2.78 (1.63 to 4.75)	4.01 (3.52 to 4.57)	3.19 (2.02 to 5.06)	3.78 (2.45 to 5.81)
UADT cancer					
		Events: 101	Events: 356	Events: 1344	Events: 248
	Former	0.62 (0.21 to 1.80)	1.61 (0.82 to 3.14)	2.25 (1.11 to 4.57)	0.96 (0.57 to 1.60)
	Current	1.46 (0.89 to 2.39)	2.74 (1.60 to 4.71)	3.99 (2.32 to 6.85)	2.07 (0.79 to 5.45)
Gastric cancer					
			Events: 3183	Events: 8197	Events: NA*
	Former	NA	1.40 (1.20 to 1.64)	1.21 (0.87 to 1.68)	1.70 (0.89 to 3.25)
	Current	NA	1.50 (1.29 to 1.74)	1.18 (0.71 to 1.94)	1.57 (0.88 to 2.81)
Other cancers					
			Events: 5500	Events: 15 451	Events: 845*
	Former	NA	1.18 (1.06 to 1.31)	1.23 (1.11 to 1.36)	1.14 (0.87 to 1.50)
	Current	NA	1.33 (1.20 to 1.47)	1.10 (0.95 to 1.28)	1.21 (0.78 to 1.89)
Respiratory diseases					
		Events: 43	Events: 252		Events: 741*
	Former	1.77 (0.76 to 4.12)	1.47 (0.99 to 2.18)	NA	1.56 (1.26 to 1.93)
	Current	1.60 (0.65 to 3.93)	1.56 (1.07 to 2.26)	NA	1.35 (1.10 to 1.64)

*Some studies did not report their number of events: only those with numbers specified included.
UADT cancer included oesophageal, oral, nasopharyngeal and laryngeal cancer.
Other cancers included colon, rectum, liver, gallbladder, pancreas, skin, breast, uterus, ovary, prostate, bladder, kidney, ureter, brain, thyroid cancer, lymphoma, multiple myeloma and leukaemia.
Other Asian countries included Hong Kong, India, Singapore, Taiwan and Thailand.
NA, not available; UADT cancer, upper aero-digestive tract cancer.

negligible harm, and less than 10% of Chinese people know that smoking causes CHD.[14] To some extent, this is also true in other Asian countries.[7 15 16] This unfavourable phenomenon among Asians contrasts with the almost universal recognition of the causal associations of smoking and (particularly) CHD, stroke and lung cancer among people in the West.[6 7]

This study has some limitations. First, a number of the included studies explored the RRs for disease-specific mortality without excluding participants who had a history of the disease of interest at baseline, so that true incidence was not always found. Second, smoking status was only recorded at study baseline, but is certain to have changed over follow-up for many participants. Third, smoking status is crudely defined—for example, not including number of years of smoking or average amounts smoked, but the broad categorisation has increased the number of studies available for inclusion and otherwise controlled variability. Forth, the categories of UADT cancer and other cancers were heterogeneously composed, and the RRs for smoking in different anatomical sites may have varied.[63] Finally, this meta-analysis was restricted to English-language publications in order to minimise bias that may have been introduced by our inability to access local-language journals and to maximise study quality.[84] However, we acknowledge that preclusion of non-English studies has the potential to have introduced publication bias into the analyses.

What is already known on this subject

Smoking is hazardous for cardiovascular diseases, cancer and respiratory diseases, but quitting smoking reverses the harmful effects of smoking on diseases that are closely associated with smoking.

What this study adds

This study provides the most reliable estimates as to the association between smoking, quitting and cause-specific illness in Asian populations, indicating that smoking is unquestionably a major contributor to ill health and death; however, the beneficial effects of quitting are not yet always apparent, most probably because quitting is a consequence of ill health and the relative unpopularity of smoking cessation in many Asian populations.

In contrast to the West which has witnessed a steady decline in the prevalence of smoking over the last few decades owing in part to widespread awareness of the harms that smoking does, many tens of millions of smokers across Asia remain oblivious to the hazards of cigarette smoking. This review provides the most reliable evidence to date of the impact of smoking on a broad array of illnesses specifically in Asian populations and offers convincing evidence as to the likely benefits from quitting the habit. Such information is essential for effective public health campaigns that aim to convince smokers across Asia to quit and dissuade others from taking up the habit, in order to prevent the many millions of smoking-related deaths that are predicted to occur in the next couple of decades, if current smoking patterns in Asia persist.

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