2.2 Pipe, cigar, bidi and other tobacco smoking

2.2.1 *Pipe and cigar smoking*

(*a*) *Introduction*

Although cigar and pipe smoking are less common than cigarette smoking throughout much of the world, these products are used extensively in certain countries and subcultures. Furthermore, the resurgence in the use of premium cigars in the USA between 1993 and 1997 illustrates how aggressive marketing of a specific tobacco product can rapidly increase its usage, even in cultures where it appears to be no longer fashionable.

The data on cancer risk in relation to cigar and pipe smoking are more limited than those available from studies of cigarette smoking. Fewer people have exclusively smoked cigars and/or pipes than have exclusively smoked cigarettes. The published studies are generally based on men, even though women in certain countries smoke cigars and/or pipes. Most studies of smoking cessation have greater statistical power to examine cigarette smoking than smoking of cigars or pipes. The smaller number of exclusive cigar and/or pipe smokers limits the opportunity to examine cancer risk in relation to the amount and duration of smoking, or to assess interactions with alcohol consumption. Persons who smoke cigarettes in combination with cigars and/or pipes typically have a risk for tobacco-attributable cancers that is intermediate between those who smoke cigarettes only and those who exclusively smoke cigars or pipes. The analyses presented here pertain only to exclusive cigar and/or pipe smokers, excluding smokers who also smoked cigarettes. While the main characteristics of the case–control studies are presented together with the results of the studies, the reader is referred to the beginning of Section 2 for a description of the cohort studies presented.

The tables are subdivided between (a) studies on smokers of pipes only and cigars only and (b) studies on smokers of both pipes and cigars, and studies that combined pipe and/or cigar smokers in one category.

(*b*) *Cancer of the lip, oral cavity and pharynx*

(i) *Cancer of the lip*

Clinical reports as early as 1795 linked pipe smoking with carcinoma of the lip (ICD-9: 140) and tongue (ICD-9: 141) (Sömmering, 1795; Clemmesen, 1965) as noted by Doll (1998). These reports were not taken very seriously, however, and these carcinomas were generally attributed to the heat of the clay pipe stem rather than to any intrinsic carcinogenicity of tobacco (Doll, 1998). Several case series and case reports published since the 1920s have noted the association of lip cancer with various combinations of pipe smoking, sunlight, ionizing radiation, and/or alcohol consumption (Broders, 1920; Ahlbom, 1937; Ebenius, 1943; Bernier & Clark, 1951; Hämäläinen, 1955; Wynder *et al*., 1957).

Two large case–control studies of lip cancer provide information on the relationship of lip cancer with pipe and cigar smoking. Keller (1970) studied 314 male cases, representing a 20% sample of patients discharged from all Veterans Administration hospitals in

the USA from 1958 until 1962. Two control groups were identified by sampling — one of patients with cancers of the mucous membrane of the mouth and pharynx, the other of patients discharged during the same period with no oral or pharyngeal cancer. Smoking of pipes, cigars and cigarettes was significantly associated with lip cancer. [The Working Group noted that the data did not include the amount smoked or duration of smoking and that only frequencies of exposure were compared.]

Spitzer *et al*. (1975) studied all male cases of squamous-cell carcinoma of the lip occurring in Newfoundland, Canada, over an 11-year period (1961–71; 366 cases). Three control groups were selected: 132 patients with oral cavity cancer, 81 patients with squamous-cell carcinoma of the skin of the head and neck and 210 randomly selected population controls. In comparison with the population controls, the relative risk for lip cancer associated with pipe smoking, adjusted for age, was 1.5 ($p < 0.05$). [The Working Group noted that the study focused on risk for lip cancer related to the occupation of fishing and gave no other information on tobacco use.]

Subsequent case–control and prospective studies of oropharyngeal cancer have not been sufficiently large to examine lip cancer separately in relation to exclusive use of pipes and/or cigars.

(ii) *Oral and pharyngeal cancer*

Cohort studies

Table 2.2.1 presents the results from seven cohort studies that looked at cancers of the oral cavity and pharynx (ICD-9: 140–149) among men who smoked exclusively cigars and/or pipes (Hammond & Horn, 1958; Kahn, 1966; Doll & Peto, 1976; Carstensen *et al*., 1987; Shanks & Burns, 1998; Iribarren *et al*., 1999; Shapiro *et al*., 2000).

The largest study was based on 12 years of follow-up of the Cancer Prevention Study I (CPS-I) cohort (Shanks & Burns, 1998). Twenty-five deaths from cancers of the oral cavity and pharynx were identified between 1959 and 1972 among the 15 191 men who reported current and exclusive smoking of cigars at the time of enrolment in the study. The age-standardized relative risk for death from cancer of the oral cavity and pharynx was 7.9 (95% CI, 5.1–11.7) among all cigar smokers, relative to lifelong nonsmokers and increased with the number of cigars smoked per day to 15.9 (95% CI, 8.7–26.8) in men who smoked five or more cigars per day. The corresponding estimate for men who reported current smoking of cigarettes exclusively was 8.2 (95% CI, 7.2–9.4). Mortality results were not reported for the 9623 men who smoked exclusively pipes at the time of enrolment in the study, or for former smokers of either cigars or pipes.

Iribarren *et al*. (1999) reported a higher incidence of cancer of the oral cavity and pharynx among 1546 men who reported current smoking of cigars only and no past cigarette smoking at the time of enrolment in the Kaiser Permanente Medical Care Program between 1964 and 1973 than in nonsmokers. Follow-up from 1971 until 1996 identified eight subjects with oral and pharyngeal cancer among the cigar smokers. The relative risk among cigar smokers compared with that of 16 228 men who had never smoked cigarettes and did not smoke a pipe at enrolment was 2.6 (95% CI, 1.2–5.8). Among cigar smokers,

risk was higher among men who smoked five or more cigars per day (relative risk, 7.2; 95% CI, 2.4–21.2) than in those who smoked less than five cigars per day (relative risk, 1.3; 95% CI, 0.4–4.4). [The Working Group noted that the inclusion of former pipe smokers in the referent group in this analysis potentially underestimates the association between cigar smoking and cancer of the oral cavity and pharynx.]

Shapiro *et al*. (2000) examined death rates from cancers of the oral cavity and pharynx among 7888 current and 7868 former cigar smokers in the Cancer Prevention Study II (CPS-II), followed from 1982 to 1994. The relative risk was highest among men who reported smoking three or more cigars per day (relative risk, 7.6; 95% CI, 2.9–19.6) and those who had smoked cigars for ≥ 25 years (relative risk, 4.6; 95% CI, 1.6–13), relative to lifelong nonsmokers.

Case–control studies

The case–control studies published since 1986 have consistently shown an increased risk for cancer of the oral cavity and pharynx among men who exclusively smoke cigars or pipes (Table 2.2.2).

Zheng *et al*. (1990) identified 404 patients diagnosed with histologically confirmed oral cancer (ICD 141, 143–145) at participating hospitals in Beijing in 1988–89. An equal number of controls matched on age, sex and hospital were randomly selected from non-cancer patients attending hospital for minor surgery and other conditions judged to be of less than 1-year duration. Among pipe smokers, the odds ratio adjusted for alcohol consumption, years of education, sex and age was 5.7 (95% CI, 2.4–13.3) in men and 4.9 (95% CI, 1.5–16.0) in women. The corresponding estimates associated with cigarette smoking only were 1.6 (95% CI, 1.0–2.6) in men and 2.0 (95% CI, 0.9–4.4) in women.

La Vecchia *et al*. (1998) reported an association between exclusive cigar smoking and cancers of the upper aerodigestive tract from a hospital-based case–control study in Italy and Switzerland. The cases in this study included cancers of the oesophagus as well as tumours of the oral cavity and pharynx and overlap with those in an earlier study by Franceschi *et al*. (1990).

Four other case–control studies have combined cigar and pipe smokers to examine the relationship of tobacco and alcohol consumption with cancers of the oral cavity and pharynx (Blot *et al*., 1988; Franceschi *et al*., 1990, 1992; Fernandez Garrote *et al*., 2001). The largest of these studies is that by Blot *et al*. (1988), based on 762 cases of oropharyngeal cancer diagnosed in four population-based tumour registries in the USA and 837 controls. Trained interviewers collected the information on tobacco and alcohol consumption. The relative risk estimate for men who smoked 40 or more cigars per week was 16.7 (95% CI, 3.7–76.7) when compared with the risk in never-smokers. The corresponding estimate in men who smoked 40 or more pipes per week was 3.1 (95% CI, 1.1–8.7).

Franceschi *et al*. (1990, 1992) reported a strong association between ever smoking cigars or pipes and diagnosis of cancers of the oral cavity (all subsites combined) in a hospital-based case–control study in Italy (relative risk, 20.7; 95% CI, 5.6–76.3). The

association was stronger for cancer of the mouth (relative risk, 21.9; 95% CI, 3.8–125.6) than for cancer of the tongue (relative risk, 3.4; 95% CI, 0.3–39.1).

Fernandez Garrote *et al*. (2001) examined the relationship between cigar or pipe smoking and incident cancer of the oral cavity and pharynx in a hospital-based study in Cuba. The relative risk estimate among men who smoked four or more cigars or pipes per day was 20.5 (95% CI, 4.7–89.7).

Table 2.2.3 presents the results of two studies that have stratified the analysis of cancer of the oral cavity and pharynx in relation to cigar and/or pipe smoking by levels of alcohol consumption (Blot *et al*., 1988; Iribarren *et al*., 1999). Men who smoked cigars and/or pipes and consumed three or more alcoholic drinks per day (Iribarren *et al*., 1999) or 30 or more alcoholic drinks per week (Blot *et al*., 1988) had a substantially higher risk than men who drank alcohol but abstained from smoking, or smoked pipe and/or cigar but drank alcohol only occasionally.

(*c*) *Lung cancer*

In most published cohort studies (Table 2.2.4) and case–control studies (Table 2.2.5), men who exclusively smoke cigars and/or pipes have a consistently higher risk for cancer of the trachea, lung and bronchus (ICD-162) than men who have never smoked any tobacco product.

Lung cancer risk increased with the number of cigars smoked per day in both the CPS-I (Shanks & Burns, 1998) and CPS-II (Shapiro *et al*., 2000) cohorts and in the Kaiser Permanente Medical Care Program cohort (Iribarren *et al*., 1999)

Lung cancer risk increased with the amount and/or duration of smoking in two large European multi-centre, hospital-based case–control studies (Lubin *et al*., 1984; Boffetta *et al*., 1999) and in a case–control study in China (Lubin *et al.*, 1992).

In the case–control by Boffetta *et al.* (1999), lung cancer risk decreased with time since cessation of cigar or pipe smoking.

The relationship between depth of inhalation and lung cancer risk from cigar and/or pipe smoking has been examined in several studies (Lubin *et al*., 1984; Benhamou *et al*., 1986; Shanks & Burns, 1998; Boffetta *et al*., 1999; Shapiro *et al*., 2000). Lung cancer risk was generally highest in cigar smokers who report that they inhale the smoke, but cigar smokers who report no inhalation still have a lung cancer risk two to five times higher than that for lifelong nonsmokers (Boffetta *et al*., 1999; Shapiro *et al*., 2000). Men who had switched from cigarette smoking to pipes or cigars reported deeper inhalation of the smoke and had higher risks for lung cancer than men who had always smoked pipes or cigars (Wald & Watt, 1997).

There is some evidence that the risk for lung cancer from cigar smoking may have increased over time. The relative risk estimates in cohort studies from the 1950s and 1960s generally ranged from 1.5 to 2.0 for men who were current smokers of either pipes or cigars at the time of the study (Kahn, 1966). However, all of the cohort studies (Doll & Peto, 1976; Carstensen *et al*., 1987; Lange *et al*., 1992; Tverdal *et al*., 1993; Ben-Shlomo *et al*., 1994; Shanks & Burns, 1998; Iribarren *et al*., 1999; Shapiro *et al*., 2000) and

case–control studies (Lubin & Blot, 1984; Benhamou *et al*., 1986; Damber & Larsson, 1986; Boffetta *et al*., 1999) published after 1975 have reported relative risk estimates of > 2.0, many with point estimates above 4.0.

(*d*) *Laryngeal cancer*

(i) *Cohort studies*

Cigar and pipe smoking were found to be strongly associated with increased risk for cancer of the larynx (ICD-9: 161) among men in three cohort studies (Table 2.2.6) (Kahn, 1966; Shanks & Burns, 1998; Shapiro *et al*., 2000).

Kahn (1966) identified six deaths from laryngeal cancer among male US veterans who smoked exclusively cigars at the time of enrolment in the US Veterans' Study and were followed from 1954 until 1962. The age-adjusted relative risk estimate associated with current cigar smoking was 10.3 (95% CI, 2.6–41.3).

Death from laryngeal cancer was associated with cigar smoking in analyses based on a 12-year follow-up of men in the CPS-I cohort (Shanks & Burns, 1998). The age-adjusted relative risk associated with current cigar smoking was 10.0 (95% CI, 4.0–20.6), based on seven deaths from laryngeal cancer among cigar smokers. The relative risk estimate was increased to 26.0 (95% CI, 8.4–60.7) among men who smoked five or more cigars per day and to 53.3 (95% CI, 0.7–296) among those who reported moderate to deep inhalation. The increased risk for laryngeal cancer associated with current cigar smoking during the 12-year follow-up was similar to the increased risk associated with current cigarette smoking during the first four years of follow-up [relative risk, 10.0; 95% CI, 3.5–28.5] (US Department of Health and Human Services, 1989).

Seven deaths from laryngeal cancer were recorded in CPS-II during follow-up from 1982 until 1994 among men who exclusively smoked cigars (Shapiro *et al*., 2000). Current cigar smoking was associated with an increased death rate from laryngeal cancer compared with never-smokers (relative risk, 10.3; 95% CI, 2.6–41.0). The corresponding age-adjusted estimate associated with current cigarette smoking was 10.5 (95% CI, 3.6–30.4) among men in CPS-II during the first 4 years of follow-up (1982–86) (US Department of Health and Human Services, 1989). In dose–response analyses based on a small number of cases, the relative risk associated with cigar smoking was higher in current smokers than in former smokers, in those who smoked more cigars per day, who reported smoking for 25 or more years and who reported inhaling the cigar smoke.

(ii) *Case–control study*

In a hospital-based case–control study in northern Italy, Franceschi *et al*. (1990) identified 162 incident cases of men with laryngeal cancer and 1272 controls between June 1986 and June 1989 (Table 2.2.7). Only one case exclusively smoked cigars or pipes, whereas 94% of cases and 76% of controls smoked cigarettes.

Several of the studies that examined the relation of cigar and/or pipe smoking to laryngeal cancer are not considered here, either because they included persons who also

smoked cigarettes (Falk *et al*., 1989; Muscat & Wynder, 1992) or because cigarette smokers were included in the referent group (Freudenheim *et al*., 1992).

(*e*) *Oesophageal cancer*

(i) *Cohort studies*

Exclusive smoking of cigars and/or pipes has been associated with increased risk for cancer of the oesophagus (ICD-9: 150) in several cohort studies (Table 2.2.8) (Kahn, 1966; Carstensen *et al*., 1987; Shanks & Burns, 1998; Shapiro *et al*., 2000).

In the US Veterans' Study, 14 deaths from oesophageal cancer occurred between 1954 and 1962 among men who, at enrolment, reported currently or formerly smoking cigars exclusively (Kahn, 1966). Risk was higher among current cigar smokers (relative risk, 5.3; 95% CI, 2.4–12.1, based on 12 deaths), than in former cigar smokers (relative risk, 2.4; 95% CI, 0.5–10.9, based on two deaths). Few male veterans had smoked pipes exclusively. The association between current pipe smoking and oesophageal cancer was based on only three deaths (relative risk, 2.0; 95% CI, 0.6–7.1).

Pipe and cigar smoking were associated with similar increases in death rate from oesophageal cancer in a cohort of 25 129 Swedish men (Carstensen *et al*., 1987). The Swedish Census Study cohort is unusual in that 27% of the men smoked a pipe, whereas only 5% smoked exclusively cigars and 32% cigarettes. The relative risk estimate associated with current pipe smoking was 3.6 (95% CI, 1.1–11.8, based on six deaths), whereas the association with current cigar smoking was 6.5 (95% CI, 1.3–33.5, based on two deaths).

The largest study of the association of oesophageal cancer with cigar smoking was based on CPS-I, in which 30 deaths from oesophageal cancer were identified among 15 191 men who reported exclusive cigar smoking at the time of enrolment (Shanks & Burns, 1998). The overall relative risk associated with current cigar smoking was 3.6 (95% CI, 2.2–5.6) relative to lifelong nonsmokers. Risk increased with the number of cigars smoked per day and with the self-reported depth of inhalation.

Shapiro *et al*. (2000) identified 17 deaths from oesophageal cancer among 15 756 men participating in CPS-II who reported current or former cigar smoking at the time of enrolment and were followed from 1982 through 1994. The relative risk estimate was slightly higher in current cigar smokers (relative risk, 1.8; 95% CI, 0.9–3.7) than in former cigar smokers (relative risk, 1.3; 95% CI, 0.6–2.8). Dose–response analyses based on nine deaths among current cigar smokers showed an increase in the risk of oesophageal cancer with the duration of smoking, but not with the number of cigars smoked per day or with depth of inhalation.

(ii) *Case–control studies*

The case–control studies on smoking and oesophageal cancer are summarized in Table 2.2.9 (Franceschi *et al*., 1990; Kabat *et al*., 1993; La Vecchia *et al*., 1998).

Kabat *et al*. (1993) examined the relationship of pipe and/or cigar smoking to specific histological types of oesophageal cancer in a hospital-based case–control study of 431 male

cases and 4544 hospital controls in the USA. Eleven cases of squamous carcinoma of the oesophagus and nine cases of adenocarcinoma of the distal oesophagus or gastric cardia had smoked pipes and/or cigars only. The risk among pipe and/or cigar smokers was not significantly higher than that of lifelong nonsmokers for squamous carcinoma (relative risk, 1.8; 95% CI, 0.8–4.1) or adenocarcinoma (relative risk, 1.1; 95% CI, 0.5–2.3).

None of the studies of pipe and/or cigar smoking in relation to oesophageal cancer have been sufficiently large to assess the possible interactions between smoking and alcohol consumption.

(*f*) *Stomach cancer*

Pipe and/or cigar smoking were consistently associated with a small increase in incidence of stomach cancer (ICD-9: 151) in most cohort studies (Table 2.2.8) and case–control studies (Table 2.2.9), but the number of cases who smoked cigars and/or pipes exclusively was small and the 95% confidence intervals in these studies often included the null.

Chao *et al*. (2002) examined the relationship between tobacco smoking and death from stomach cancer among men who currently or formerly smoked cigars or pipes at the time of enrolment in CPS-II. Increased mortality from stomach cancer was associated with current cigar smoking (relative risk, 2.3; 95% CI, 1.5–3.5; 25 deaths) and pipe smoking (relative risk, 1.3; 95% CI, 0.8–2.2; 16 deaths). Relative risk estimates were highest in men who reported smoking five or more cigars per day (relative risk, 4.2; 95% CI, 2.3–7.6) and those who inhaled the smoke (relative risk, 3.9; 95% CI, 1.9–8.0).

(*g*) *Colorectal cancer*

Current pipe and/or cigar smoking were associated with an increased risk for cancer of the colon and/or rectum (ICD-9: 153–4) in several cohort studies (Table 2.2.10).

The largest analysis is based on follow-up of the US Veterans' Study from 1954 until 1980. Heineman *et al*. (1995) reported a higher death rate from both colon cancer (relative risk, 1.3; 95% CI, 1.1–1.4) and rectal cancer (relative risk, 1.4; 95% CI, 1.2–1.8) among men who exclusively smoked pipes and/or cigars compared with never-smokers. The relative risk for colon cancer increased significantly with the number of cigars smoked per day (p for trend = 0.004) and the relative risk for rectal cancer increased with the number of pipes smoked per day (p for trend = 0.007).

Current smoking of pipes and/or cigars was associated with an increased risk for colon or colorectal cancer in the British Doctors' Study (relative risk, 1.7; 95% CI not stated) (Doll & Peto, 1976), the Lutheran Brotherhood Insurance Study (relative risk, 1.6; 95% CI, 0.8–3.2) (Hsing *et al*., 1998) and the Finnish Mobile Clinic Health Examination Study (relative risk, 1.5; 95% CI, 0.8–2.6) (Knekt *et al*., 1998). Current cigar and/or pipe smoking was also significantly associated with increased mortality from colorectal cancer among men in the CPS-II who had smoked for 20 or more years (relative risk, 1.3; 95% CI, 1.1–1.6) (Chao *et al*., 2000).

The Working Group was aware of no published case–control studies of exclusive pipe and/or cigar smoking in relation to cancers of the colon and rectum.

(*h*) *Cancer of the liver and intrahepatic bile ducts*

Carstensen *et al.* (1987) reported an association between current cigar smoking and increased death rates from cancer of the liver and biliary passages (ICD-9: 155–156) among 25 129 Swedish men followed from 1963 to 1979 (relative risk, 7.2; 95% CI, 2.2–23.4, based on four deaths) (Table 2.2.11).

Hsing *et al.* (1990a) reported an increased risk for primary liver cancer among current pipe and/or cigar smokers participating in the US Veterans' Study (relative risk, 3.1; 95% CI, 2.0–4.8).

(*i*) *Cancer of the gallbladder and extrahepatic bile ducts*

Cancer of the extrahepatic bile ducts (ICD-O: 156.1) was also associated with cigar and/or pipe smoking in a population-based case–control study of 105 histologically confirmed cases and 255 controls in Los Angeles County, USA (Table 2.2.12) (Chow *et al*., 1994). Two cases of cancer of the extrahepatic bile duct occurred among men who had ever smoked cigars or pipes exclusively (relative risk, 1.6; 95% CI, 0.3–9.9), compared with lifelong nonsmokers. Two additional cases involved the ampulla of Vater (relative risk, 7.6; 95% CI, 0.6–100.4).

(*j*) *Cancer of the pancreas*

Pipe and/or cigar smoking were associated with an increased risk for pancreatic cancer (ICD-9: 157) in most of the cohort studies (Table 2.2.13) and case–control studies (Table 2.2.14).

(i) *Cohort studies*

The largest study encompassed a 12-year follow-up of men in CPS-I (Table 2.2.13) (Shanks & Burns, 1998). The age-adjusted relative risk for death from pancreatic cancer among current exclusive cigar smokers, compared with lifelong nonsmokers, was 1.6 (95% CI, 1.2–2.1), based on 56 deaths. The risk for pancreatic cancer increased with the number of cigars smoked per day and with the depth of inhalation of the cigar smoke.

Higher risks for pancreatic cancer in current cigar smokers than in nonsmokers were also reported among men in the US Veterans' Study (relative risk, 1.5; 95% CI, 0.99–2.3, 27 deaths) (Kahn, 1966), in the Kaiser Permanente Medical Care Program Study (relative risk, 1.2; 95% CI, 0.5–2.9, 6 cases) (Iribarren *et al*., 1999) and in CPS-II (relative risk, 1.3; 95% CI, 0.9–1.9, 28 deaths) (Shapiro *et al*., 2000).

Current pipe smoking was significantly associated with increased risk for pancreatic cancer in the Swedish Census Study (relative risk, 2.8; 95% CI, 1.5–5.2) (Carstensen *et al*., 1987).

(ii) *Case–control study*

In the hospital-based case–control study reported by Muscat *et al*. (1997), men who ever smoked cigars exclusively had an increased risk for pancreatic cancer (relative risk, 3.1; 95% CI, 1.4–6.9) (Table 2.2.14). For ever smoking a pipe, the odds ratio for pancreatic cancer incidence was 1.8 (95% CI, 0.9–5.3).

(*k*) *Cancer of the bladder and kidney*

Epidemiological studies of cigar and/or pipe smoking in relation to cancers of the urinary bladder (ICD-9: 188) and kidney (ICD-9: 189) are summarized in Table 2.2.15 (cohort studies) and Table 2.2.16 (case–control studies). Men who exclusively smoked pipes had a significantly increased risk for bladder cancer in the Swedish Census Study (relative risk, 4.0; 95% CI, 1.9–8.6), the largest prospective study to evaluate pipe smoking (Carstensen et al., 1987). Men who smoked more than three cigars daily had an increased risk for bladder cancer relative to that of lifelong nonsmokers in CPS-I (Shanks & Burns, 1998) and CPS-II (Shapiro et al., 2000).

Taken separately, none of the cohort or case–control studies included a sufficient number of cases who smoked pipes or cigars exclusively to evaluate dose–response relationships precisely. The largest study of bladder cancer was the pooled analysis of European case–control studies by Pitard *et al.* (2001). The risk for bladder cancer increased significantly with number of years of smoking for both pipes (p for trend = 0.006) and cigars (p for trend < 0.001).

The four studies on kidney cancer (Kahn, 1966; Jensen *et al.*, 1988; McLaughlin *et al.*, 1995; Iribarren *et al.*, 1999) had limited statistical power to assess associations between pipe or cigar smoking and cancers of the renal pelvis or parenchyma.

(*l*) *Prostate cancer*

Men who exclusively smoked pipes or cigars had higher death rates from prostate cancer (ICD-9: 185) than lifelong nonsmokers during the first 8.5 years of follow-up of the US Veterans' Study (Kahn, 1966). Compared with lifelong nonsmokers, the relative risk estimate was 1.5 (95% CI, 0.98–2.4) for men who currently smoked pipes, and 1.5 (95% CI, 1.03–2.2) for current cigar smokers. Little association was seen between prostate cancer mortality and pipe and/or cigar smoking in the 26-year follow-up of the same cohort (Hsing *et al*., 1991). [The Working Group noted that the information on smoking was not updated during either follow-up, so that misclassification of exposure could have attenuated the findings in the longer follow-up.]

Hsing *et al*. (1990b) also studied the much smaller Lutheran Brotherhood Insurance Study cohort (Table 2.2.17). Mortality from prostate cancer was higher among men who ever smoked pipes or cigars than in lifelong nonsmokers (relative risk, 1.6; 95% CI, 0.7–3.5), although the association was based on only nine deaths. No increase in risk for prostate cancer was seen among men who currently smoked pipes in the Norwegian Screening Study (Tverdal *et al*., 1993) or among men who ever smoked pipes or cigars in

a population based case–control study in Montreal, Canada (Table 2.2.18; Sharpe & Siemiatycki, 2001).

(*m*) *Cancer of the haematopoietic system*

The cohort studies (Table 2.2.19) and case–control studies (Table 2.2.20) that have related cigar and/or pipe smoking to haematopoietic cancers are generally too small to be informative.

(*n*) *Cancer of other organs*

The Norwegian Screening Study examined the relationship between pipe and/or cigar smoking and the risk for brain cancer (Tverdal *et al.*, 1993). The number of cases was too small to be informative (Table 2.2.21).

2.2.2 *Bidi and other tobacco smoking*

(*a*) *Introduction*

This section covers smoking in forms practiced mainly in South Asia and in Africa. Most of the available studies have been conducted in India on the association of cancer with bidi smoking as well as, depending on the region studied, smoking of chillum (clay pipe), cheroot and chutta, including reverse chutta smoking. Other studies have reported on *khii yoo* smoking in Northern Thailand, kiraiku smoking in Kenya and reverse cigarette smoking.

Bidi smoking is the most common form of tobacco smoking in India. The bidi is an indigenous smoking stick 4–8 cm long, usually containing 0.15–0.25 g coarse tobacco flakes rolled in a rectangular piece of dried *temburni* leaf (*Diospyros melanoxylon*). The number of bidis produced and consumed in India is 7–8 times higher than the number of cigarettes, thus most studies on health risks to smokers in India have concentrated on bidi smoking. Moreover, cigarette smoking is common generally only in higher socioeconomic groups. Besides bidis and cigarettes, other smoking habits include various indigenous forms of pipe and cheroot smoking. Cheroots are small cigars made of heavy-bodied cured tobacco rolled in a dried tobacco leaf and tied with a thread. Chuttas are coarsely prepared cheroots. The length of chuttas varies from 5 to 12 cm. Chutta smoking is widespread in coastal areas of Andhra Pradesh, Tamil Nadu and Orissa. The hookah, or hooka, is a pipe that allows the tobacco smoke to pass through water before the smoker inhales it (water pipe). The chillum is a straight, conical clay pipe used for tobacco smoking.

When assessing the carcinogenic effects of smoking, it is necessary to consider several potentially confounding common habits such as chewing of betel quid with tobacco, chewing tobacco with or without lime, and drinking alcoholic beverages. Betel-quid chewing is the chewing of a quid made up of fresh betel leaves (*Piper betle*), areca nut (*Areca catechu*), slaked lime (calcium hydroxide) and almost always, tobacco. Various

condiments are often added in small quantities. Other forms of smokeless tobacco include a powder or paste used to clean the teeth and snuff.

(*b*) *Cancer of the oral cavity and pharynx*

Results of case–control studies on bidi and other tobacco smoking and cancer of the oral cavity and pharynx are presented in Table 2.2.22.

(i) *Cancer of the oral cavity*

Three hospital-based case–control studies on cancers of subsites of the oral cavity (gingiva, tongue and floor of the mouth, buccal and labial mucosa) were conducted at the Regional Cancer Centre in Trivandrum, Kerala, a state in southern India, during 1983–84. Control patients, matched for age (within 5 years), sex and religion, were selected among outpatients who came for treatment to the Medical College in Trivandrum, with respiratory, intestinal and genitourinary infections or who came for a cancer check-up for sites other than the head and neck. Both cases and controls were interviewed by trained social workers to elicit sociodemographic information, history of habits and clinical details. All cancer cases were confirmed by biopsy. Chewing of betel quid with or without tobacco, bidi smoking, cigarette smoking, alcohol use and nasal snuff inhalation were the main habits practiced by the study population. These studies analysed only men for smoking and alcohol habits because few women practiced these habits.

The case–control study on carcinoma of the gingiva consisted of 187 cases and 895 matched controls (Sankaranarayanan *et al*., 1989a). After using forward stepwise logistic regression on the four main habits of chewing of betel quid with tobacco, bidi smoking, alcohol drinking and snuff inhalation, the relative risk for smoking bidis for 20 years or less was 2.6 (95% CI, 0.7–9.9) and that for smoking bidis for more than 20 years was 2.1 (95% CI, 1.2–27.9).

The study on cancer of the tongue ($n = 188$) and floor of the mouth ($n = 40$) included 158 men and 70 women (Sankaranarayan *et al*., 1989b). Two controls were selected for each case and matched for age (within 5 years), sex and religion. Forward stepwise logistic regression was used to estimate relative risk for chewing of betel quid with tobacco, bidi smoking, bidi–cigarette smoking and cigarette smoking. A relative risk of 7.5 (95% CI. 2.6–21.7) was noted for men who smoked 20 or more bidis per day.

The study of cancer of the buccal and labial mucosa included 413 cases and 895 controls (Sankaranarayan *et al*., 1990a). When forward stepwise logistic regression was used to create a multivariate model of risk for cancer of the buccal and labial mucosa adjusted for other habits, bidi smoking had a relative risk of 2.9 (95% CI, 1.3–6.6) for a duration of the habit up to 20 years and 1.7 (95% CI, 1.1–2.6) for a habit that continued for 21 years or more.

A hospital-based case–control study was carried out during 1980–84 at the Tata Memorial Hospital, a cancer hospital in Mumbai (Bombay), India, on 713 men who were histopathologically diagnosed with oral cancer and 635 controls free from cancer, benign lesions or infectious diseases (Rao *et al*., 1994). The average age of the case group was

50.4 years and that of the control group was 45.4 years. Those who smoked bidis had a relative risk of 1.6 (95% CI, 1.3–2.0) for oral cancer. Men who smoked hookah and chillum had a relative risk of 5.0 (95% CI, 1.4–22.0). The trends in relative risks by intensity and duration of bidi smoking were both statistically significant ($p < 0.001$). [The Working Group noted that the study had several deficiencies, particularly in the selection of controls that resulted in cigarette smoking apparently being protective for oral cancer. The data analysis seemed to be confined to univariate analysis.]

A hospital-based case–control study was undertaken on 647 male patients with tongue cancer at the Tata Memorial Hospital, in Mumbai, India, between 1980 and 1984 (Rao & Desai, 1998). During the same period, 635 men, the majority of whom had come to the hospital for a check-up and were found to be free of cancer, benign lesions and infection, were selected as unmatched controls. Habits included betel quid, areca nut, tobacco and lime, bidi, cigarettes and other forms of tobacco smoking. Bidi smoking was by far the most common smoking habit. Unconditional logistic regression was used to estimate relative risk after stratification by age and place of residence. Bidi smoking was a significant risk factor for cancer of the base of the tongue (relative risk, 5.9; 95% CI, 4.2–8.2). Bidi smoking did not pose a statistically significant relative risk for cancer of the anterior tongue at any level of smoking intensity, but the relative risks for cancer of the base of the tongue were statistically significant at all levels of smoking intensity and a statistically significant trend was observed. Duration of smoking was not a significant predictor of risk for cancer of the anterior tongue, but it was for cancer of base of the tongue, with a significant trend that peaked at 21–30 years (relative risk, 7.7; 95% CI, 4.8–13.0). A model created with unconditional logistic regression that included bidi smoking, alcohol drinking, illiteracy, non-vegetarian diet and tobacco chewing showed that the greatest risk for cancer of the base of the tongue came from smoking bidis (relative risk, 4.7; 95% CI, 3.5–6.3). Cancer of the anterior tongue was not associated with bidi smoking in this model.

A population-based case–control study of upper aerodigestive tract cancers was conducted in Bhopal, central India (Dikshit & Kanhere, 2000). Men who had cancers that had been recorded during 1986–92 by the Bhopal Population-Based Cancer Registry were potential cases. Those with tongue cancer (not otherwise specified) or registered from death certificate only were excluded. Only those subjects who gave complete information on tobacco use were included, giving 163 lung cancer patients, 247 oropharyngeal cancer patients and 148 oral cavity cancer patients (all squamous-cell carcinomas) as study cases. A total of 260 controls were randomly selected after age stratification of a sample of about 2500 men recruited during 1989–92 in a tobacco habit survey of a random sample of Bhopal voters. After adjustment for age and tobacco quid chewing, the relative risk for smokers (bidis and/or cigarettes) was 1.5 (95% CI, 0.9–2.4). Smoking for more than 30 years led to a significant relative risk for oral cavity cancer of 4.3 (95% CI, 2.0–9.1). The estimated relative risk for the highest of three levels of cumulative years of smoking was 6.0 (95% CI, 2.6–13.7).

A hospital-based case–control study of cancer of the oral cavity was conducted in three areas of southern India (Bangalore, Madras and Trivandrum) between 1996 and

1999 (Balaram *et al*., 2002). A total of 591 incident cases were enrolled (309 men, 282 women). Control subjects were selected from the same hospitals (centres) as cases and were frequency-matched by centre, age and sex. In Madras and Bangalore, the controls were relatives and friends of other cancer patients. In Trivandrum, controls were selected from general medical outpatients or attendees of the cancer clinics who had been found free of malignancy. The control group included 292 men and 290 women. Odds ratios for men who smoked bidis were: for < 20 bidis per day, 2.0 (95% CI, 1.1–3.8); and for ≥ 20 per day, 2.5 (95% CI, 1.4–4.4).

(ii) *Pharyngeal cancer*

A hospital-based case–control study of oropharyngeal cancer was carried out in Nagpur, Maharashtra in Central India (Wasnik *et al*., 1998). The cases were 123 patients newly diagnosed with oropharyngeal cancer, confirmed by histopathology. Each case was matched with two hospital controls on age and sex. For each case, one control was selected from non-cancer patients and the other from patients with cancer at sites other than head and neck. Unconditional logistic regression analysis was used with the major risk factors identified from an initial model. Odds ratios for tobacco smoking, predominantly in the form of bidi and/or chillum, were 2.3 (95% CI, 1.2–3.7) after adjusment for tobacco chewing and outdoor occupation. [The Working Group noted some problems with the data analysis.]

A case–control study was undertaken on 1698 men with pharyngeal and laryngeal cancers seen at the Tata Memorial Hospital, Mumbai from 1980 to 1984 (Rao *et al*., 1999). There were 678 patients with cancer of oropharynx, 593 patients with cancer of the hypopharynx, and 427 patients with cancer of the larynx. A total of 635 controls were selected from male outpatients at the same hospital who had been found to be free from cancer, benign tumours and infectious disease. The estimated relative risk for bidi smoking was 5.6 (95% CI, 4.1–7.6) for cancer of the oropharynx and 2.0 (95% CI, 2.0–3.5) for cancer of the hypopharynx. A dose–response relationship was observed for intensity and duration of bidi smoking for both sites. When unconditional logistic regression was performed with adjustment for alcohol, illiteracy, diet and tobacco chewing, bidi smoking was the most important factor for both sites.

In the study by Dikshit and Kanhere (2000) (described in Section 2.2.2(*b*)(i)), a high relative risk for oropharyngeal cancer among subjects who smoked only bidis (odds ratio, 7.9; 95% CI, 5.1–12.4) and a positive relationship with intensity of bidi smoking were observed.

(iii) *Oral leukoplakia*

Case reports

A case of reverse cigarette smoking was reported from the Hospital ‘De Tjongerschans’, Heerenveen, the Netherlands, where a dentist had referred a 59 year-old woman who had smoked for 40 years with the glowing end inside the mouth, having learnt the habit from her mother who originated from Aruba in the Netherlands Antilles.

Oral examination revealed a thick, leathery palatal mucosa with burnt, charred areas. The buccal mucosa at both sides showed diffuse leukoplakic lesions. Biopsy of the palatal leukoplakia showed hyperkeratosis with slight to moderate epithelial dysplasia. After 4 years of follow-up, no malignant changes were noted (Hogewind *et al.*, 1987).

A 69-year old immigrant from the Philippines was referred to the Department of Stomatology at the School of Dentistry, University of Manitoba in Winnipeg, Canada, with an unusual lesion of the hard palate. She reported having practiced reverse smoking for 10 years, having begun the habit in the Philippines. A white lesion covered her entire hard palate and near the mid-line there was an area of charred tissue. Minor salivary glands stood out as red spots, as in nicotine stomatitis. A biopsy of the hard palate revealed moderate hyperkeratinization without dysplasia. A 50-year-old woman who had emigrated from the Caribbean had a clinical history similar to that of the woman described above. She was diagnosed with hyperkeratinization without dysplasia (Stoykewych *et al.*, 1992).

Cross-sectional and case–control studies (Table 2.2.23)

A cross section of villagers aged 21 years and above, in four villages in three districts of Andhra Pradesh where it was known that reverse chutta smoking was practised, was surveyed for palatal lesions (Van der Eb *et al*., 1993). A random sample of 758 persons was drawn from the electoral rolls and 480 of them (250 women, 230 men) were examined and interviewed by health professionals with special training. Many could not be examined due to bad weather, others due to emigration or death, but refusals were uncommon. Reverse chutta smokers constituted 33.3% of the sample, about two-thirds of which were women; conventional chutta smokers amounted to 12.5% (mainly men); bidi smokers, 4.2% (all men); cigarette smokers, 2.9%; tobacco chewers, 2.1 %; and those with mixed habits, 4.2%. Non-tobacco users constituted 33.5% of the sample, about two-thirds of which were women, and 7.3% were former smokers. Palatal lesions were found with all smoking habits, but were far more common and most severe in reverse smokers. The age and sex-standardized percentages of palatal lesions were as follows: 0.9% of the men and 3.9% of the women who were nonsmokers; 55% of the bidi smokers; 54.7% of the men and 63.3% of the women who were conventional chutta smokers; and 93.0 % of the men and 92.2 % of the women who practised reverse chutta smoking. Palatal lesions found in higher proportions in reverse smokers included preleukoplakia, leukoplakia and palatal keratosis. All but one of the atrophic areas were found in current and ex-reverse chutta smokers and all the nine carcinomas found were in current reverse chutta smokers.

A population-based case–control study of leukoplakia was carried out in Kenya by house-to-house survey using a cluster-sampling technique (Macigo *et al.*, 1996). Individuals with leukoplakia found through oral examination (n = 85) were enrolled as cases. Controls (n = 141) were matched for sex, age and the cluster of origin. Tobacco was smoked in the form of cigarettes and *kiraiku* rolls, a type of local, handmade, smoking sticks, using cured, dried and crushed tobacco, rolled in any one of the following: dried banana leaves and stem peelings, dried corn husks, newspaper or other paper. The relative risk for oral leukoplakia in current cigarette smokers was 8.4 (95% CI, 4.1–17.4) and that

for current *kiraiku* smokers was 10.0 (95% CI, 2.9–43.4). In former *kiraiku* smokers, the relative risk was 4.9 (95% CI, 2.3–10.4). Duration of smoking before cessation showed a trend towards greater risk with increasing duration. A gradual downward trend was seen for the number of years since quitting *kiraiku* smoking; however, the relative risk for an interval of more than 10 years since quitting was still significantly increased. [The Working Group noted that the study did not adequately control for possible confounding with cigarette smoking.]

Intervention studies

A large controlled prospective intervention trial for primary prevention of oral cancer was conducted in India in the districts of Ernakulam (Kerala), Bhavnagar (Gujarat) and Srikakulam (Andhra Pradesh). The intervention cohort consisted of over 12 000 tobacco users of 15 years of age and older in each of the three districts. Members of this cohort were interviewed about their tobacco use and examined for the presence of oral lesions. They took part in an educational programme on tobacco use through annual follow-ups during 1977–88. The control cohort consisted of over 17 000 persons, all tobacco users aged 15 and over in randomly selected villages in the same three districts, who were examined and followed up in a similar manner to that for the intervention cohort, but with minimal educational intervention during 1966–77 (Gupta *et al.*, 1986a). Eight annual follow-up surveys were conducted after the first 2 years, covering a 10-year period (1977–88). The analysis was restricted to tobacco users with an appropriate length of follow-up period. The results are discussed district by district, and are summarized in Table 2.2.24.

Bhavnagar District

The size of the intervention cohort in Bhavnagar was 12 221 and that of the control cohort was 3704, all subjects were men as very few women used tobacco in that area. Both bidis and clay pipes were commonly smoked by men in the Bhavnagar District. A small proportion of men practised chewing habits.

After five years of follow-up, the proportion of individuals re-examined at least once in the intervention cohort was 96.5% and in the control cohort, 83.5%. The proportions of individuals who quit their tobacco habits in the control and intervention cohorts were 9% and 13%, respectively. There was little difference in the incidence rate of leukoplakia between the two cohorts (Gupta *et al.*, 1986b).

Srikakulam District

The size of the intervention cohort in Srikakulam District was 12 038 and that of the control cohort was 7542. Smoking was the major tobacco habit, practised mostly in the form of reverse chutta smoking. Men also smoked chuttas in the conventional manner, and bidis. Women practised only reverse chutta smoking. The proportions of individuals who quit their tobacco habits in the control and intervention cohorts were 3.5% and 17%, respectively.

Incidence rates of oral precancerous lesions (mainly palatal lesions associated with reverse smoking) were substantially lower in the intervention cohort than in the control cohort for all tobacco habit groups. The 5-year age-adjusted incidence rates per 1000 for palatal changes for women who were reverse smokers were 513.9 in the control area and 292.0 in the intervention area and, among men, 427.7 and 163.3, respectively. The rate ratio for the protective effect of intervention on reverse smokers was 0.38 in men and 0.57 in women (Gupta *et al.*, 1986b).

Ernakulam District

At baseline in the intervention cohort, the prevalence of leukoplakia was 2.9% in the intervention cohort and 2.7% in the control cohort (Mehta *et al.*, 1982).

After eight years of follow-up, the expected number of cases of leukoplakia in the intervention cohort was calculated using age- and sex- specific incidence rates from the control cohort. The observed number of leukoplakia was only 41% of the expected number in men and only 28 % of the expected number in women (Gupta *et al.*, 1990).

After 10 years of follow-up, 14.3% of tobacco users in the intervention cohort had discontinued their tobacco habit as compared with 4.5% in the control cohort. Among individuals who reported stopping bidi smoking, only one bidi-associated leukoplakia and one central papillary atrophy of the tongue were found, compared to the expected 5.8 leukoplakia, 6.0 central papillary atrophy and 27.1 other bidi-associated oral mucosal lesions (leukoedema, preleukoplakia and smokers' palate), based on the incidence rates among all other individuals. The differences in observed and expected rates were statistically significant ($p < 0.05$) (Gupta *et al.*, 1992).

The relative risks for malignant transformation for the nodular form of leukoplakia were reported to be 3243.2, for ulcerated leukoplakia 43.8 and for homogeneous leukoplakia 25.6 when compared with individuals with a tobacco habit, but no oral precancerous lesions (Gupta *et al.*, 1989).

[The Working Group noted the 10-year calendar time difference between the intervention and control cohorts.]

The educational intervention that was undertaken in these studies was helpful in reducing the use of tobacco in all areas and in increasing cessation rates in two of the three areas. Spontaneous regression rates of oral precancerous lesions were higher among individuals who reported stopping or reducing their tobacco use than in those who did not. The incidence rates of oral precancer were lower in the intervention cohorts in two of the areas (leukoplakia in Ernakulam and palatal changes in Srikakulam) than in the respective control cohorts.

(*c*) *Lung cancer*

In northern Thailand, hand-rolled cigars called *khii yoo* are commonly smoked. In a hospital-based case–control study conducted in Chiang Mai, Thailand, the odds ratios for lung cancer for *khii yoo* smoking were 1.2 in men and 1.5 in women ($p > 0.05$) (Simarak *et al.*, 1977).

In the case–control study by Dikshit & Kanhere (2000), described in Section 2.2.2(*b*)(i), the age-adjusted relative risk for lung cancer among smokers of bidis only was 11.6 (95% CI, 6.4–21.3) (Table 2.2.25).

A hospital-based case-control study of lung cancer was conducted in Chandigarh, northern India. A total of 235 men with cytologically or histologically confirmed lung cancer was recruited between January 1995 and June 1997. Four hundred and thirty-five male controls were selected from visitors and attendants of the patients. Results were presented both separately and combined for bidi, cigarette and hookah smoking. For the purpose of analysing smokers of different types of tobacco products, cigarette equivalents were calculated by applying a weight of 1 (= 1g of tobacco) to cigarettes, 0.5 to bidis, and 4 hookahs. The odds ratio for bidi smoking was 5.8 (95% CI, 3.4–9.7), and for hookah smoking, 1.9 (95% CI, 0.9–4.4). Risks by intensity of smoking bidis increased at successively higher intensities. The highest odds ratio for 9 pack–years was for bidi (3.9; 95% CI, 2.1–7.1), followed by hookah (1.9; 95% CI, 0.9–4.4) and cigarette (1.9; 95% CI, 0.9–4.4). There was a clear decreasing trend for years since quitting (Gupta *et al.*, 2001).

(*d*) *Laryngeal cancer*

The case–control studies on bidi smoking and laryngeal and oesophageal cancer are summarized in Table 2.2.26.

In a hospital-based case–control investigation in Trivandrum, India, information on 190 men with squamous-cell carcinoma of the larynx confirmed by biopsy and 546 male controls was collected during 1983–84 (Sankaranarayanan *et al*., 1990b). Unconditional logistic regression, sometimes with a forward stepwise approach, was used to produce estimates of relative risk adjusted for age and religion. Occasional users were excluded from the analyses of frequency, duration and age at starting smoking. All levels of intensity of bidi smoking were associated with significant relative risk estimates, ranging from 1.8 (95% CI, 1.1–2.9) to 5.1 (95% CI, 2.7–9.6), with a highly significant trend ($p < 0.001$). When duration of bidi smoking was tested in a forward stepwise logistic regression model adjusted for cigarette smoking, alcohol consumption and the combination of bidi with cigarette smoking, the relative risk for bidi smoking for more than 21 years was 7.1 (95% CI, 4.0–12.5), with a highly significant trend ($p < 0.001$). Daily intensity of bidi and cigarette smoking also exhibited a highly significant trend in this model ($p < 0.001$).

The case–control study described in the section on cancer of the pharynx (Rao *et al*., 1999) also included 427 patients with cancer of larynx. A total of 635 controls were selected from male outpatients at the same hospital who had been found to be free from cancer, benign tumours and infectious disease. Cases and controls were stratified into four 5-year age groups and by place of residence. The estimated relative risk for bidi smoking was 2.3 (95% CI, 1.7–3.2). A dose–response relationship was observed for number of bidis smoked daily. When unconditional logistic regression was performed using five factors, bidi smoking was the most important risk factor.

(*e*) *Oesophageal cancer*

A hospital-based case–control study of oesophageal cancer was carried out during 1983–84 at the Regional Cancer Centre, Trivandrum in Kerala, India (Sankaranarayanan *et al*., 1991). Among 267 cases recruited to the study, 67% were histopathologically confirmed and the remainder were radiologically diagnosed. From outpatients attending the centre and surrounding medical complex during this period, 895 controls with non-malignant or pre-malignant conditions were selected. Relative risks were adjusted for age and religion through unconditional logistic regression. Significant effects were noted in men for all levels of intensity of bidi smoking and for a duration of more than 20 years of bidi smoking (Table 2.2.26). The trends for intensity and for duration of smoking of bidis and of bidis and cigarettes were all significant. In a forward stepwise logistic regression model, duration of bidi smoking and daily frequency of bidi/cigarette smoking emerged as statistically significant factors.

A hospital-based case–control study investigated the risk for oesophageal cancer by subsite and histomorphology at the Kidwai Memorial Institute of Oncology, Bangalore, in Karnataka, India (Nandakumar *et al*., 1996). Of 549 patients (284 men, 265 women) diagnosed with oesophageal cancer between 1982 and 1985, data were collected on 343 (177 men, 166 women) using a structured questionnaire. Of these, 236 cases had a microscopically confirmed diagnosis of squamous-cell carcinoma. For each case, two controls were randomly selected from a database of 1875 patients who were proven not to have cancer or benign tumours. They were matched on sex, 5-year age group, area of residence and calendar time of their hospital visit. Among the men, 12 cases and 15 controls predominantly smoked bidis but also smoked cigarettes, and were combined with the bidi smokers. Similarly, four men who predominantly smoked cigarettes but also smoked bidis were considered to be cigarette smokers. Women were not included in the analyses because few of them practised those habits. After adjusting for tobacco chewing, chewing of betel quid without tobacco, alcohol drinking and cigarette smoking, bidi smoking had an odds ratio of 4.0 (95% CI, 2.3–6.8) for cancer of the oesophagus. Bidi smoking resulted in a significantly elevated risk for all three segments of the oesophagus, but the highest was for the upper third (odds ratio, 7.1; 95% CI, 1.1–46.8), followed by the middle third (odds ratio, 6.0; 95% CI, 2.5–14.5) and the lower third (odds ratio, 3.9; 95% CI, 1.4–10.7).

In a case–control study conducted from February 1994 to March 1997 at the All India Institute of Medicine (AIIMS), New Delhi, 150 patients with histopathologically confirmed oesophageal cancer were enrolled as cases (Nayar *et al*., 2000). An equal number of controls were selected from individuals accompanying patients to the same hospital, after matching for age (± 5 years), sex and socioeconomic status. Both cases and controls had to meet the criterion that they had not suffered from any major illness in the past that had caused them to change their dietary consumption pattern. Data were stratified on socioeconomic status into five groups. Using unconditional stepwise logistic regression, bidi smoking showed an odds ratio of 2.0 (95% CI, 1.2–3.3). This was adjusted for other

risk factors in the model, such as chewing of betel leaf with tobacco and low consumption of vegetables other than leafy vegetables.

(*f*) *Stomach cancer*

A hospital-based case–control study of stomach cancer was conducted at the Cancer Institute (WIA), Madras, located in south India, as part of a multi-centre study (Gajalakshmi & Shanta, 1996; see Table 2.2.27). Patients with stomach cancer confirmed by histology, endoscopy, barium meal or surgery were included in the study. The control pool was formed by cancer patients diagnosed at the Cancer Institute, excluding those with cancer of the oral cavity, pharynx, larynx, lung, urinary bladder, pancreas and gastro-intestinal tract. Each case was matched with a cancer patient from the control pool on age, sex, religion and mother tongue. Details collected on smoking habits included type of tobacco smoked, age at starting smoking, amount smoked per day, and age at cessation (more than 6 months prior to diagnosis of cancer). The odds ratio for stomach cancer for current smoking of any type of tobacco was 2.7 (95% CI, 1.8–4.1); for current bidi smoking the odds ratio was 3.2 (95% CI, 1.8–5.7); that for chutta smoking was 2.4 (95% CI, 1.2–4.9); that for having more than one smoking habit was 8.2 (95% CI, 1.7–38.9). The trend for increasing lifetime exposure to bidi smoking was highly significant ($p < 0.001$). A significant trend for increasing lifetime chutta smoking was also seen. In a multivariate model including tobacco habits, alcohol drinking and various dietary factors, as well as income, education and area of residence, the odds ratios for current smokers, former smokers and ever-smokers were not substantially different from those in the above models.

Table 2.2.1. Cohort studies on exclusive pipe and/or cigar smoking and cancer of the oral cavity and pharynx

Reference Study and years of study	Site ICD codes	Smoking category (cases or deaths)	Relative risk (95% CI)	Variables adjusted for/ comments
Pipe only or cigar only				
Hammond & Horn (1958) American Cancer Society (9-State) Study 1952–55	Oral cavity, pharynx, larynx, oesophagus	Never-smoker (4) Ever pipe only (7) Ever cigar only (10)	1.0 3.5 [1.02–12.0] 5.0 [1.6–15.9]	Age
Kahn (1966) US Veterans' Study 1954–62	Oral cavity 140–144 (ICD-7)	Never-smoker (11) Former pipe only (1) Current pipe only (4) Former cigar only (2) Current cigar only (9)	1.0 2.5 [0.3–19.1] 3.1 [0.99–9.8] 3.0 [0.7–13.5] 4.1 [1.7–9.9]	Age
	Pharynx 145–148 (ICD-7)	Never-smoker (4) Former pipe only (0) Current pipe only (1) Former cigar only (1) Current cigar only (0)	1.0 – 2.0 [0.2–17.7] 3.7 [0.4–32.8] –	Age
Carstensen *et al*. (1987) Swedish Census Study 1963–79	Oral cavity, pharynx, larynx 140–146, 148, 161 (ICD-8)	Never-smoker (4) Current pipe only (3) Current cigar only (1)	1.0 1.4 [0.3–6.3] 0.6 [0.1–5.4]	Age, residence
Shanks & Burns (1998) Cancer Prevention Study I 1959–72	Oral cavity, pharynx, excluding salivary glands	Never-smoker (18) Current cigar only (25) 1–2 cigars/day 3–4 cigars/day > 5 cigars/day No inhalation Slight inhalation Moderate and deep inhalation	1.0 7.9 (5.1–11.7) 2.1 (0.4–6.2) 8.5 (3.7–16.8) 15.9 (8.7–26.8) 7.0 (4.1–11.0) 7.8 (1.6–22.9) 27.9 (5.6–81.5)	Age
	Pharynx	Never-smoker (10) Current cigar only (12) 1–2 cigars/day 3–4 cigars/day > 5 cigars/day	1.0 6.7 (3.5–11.8) 3.8 (0.8–11.1) 7.5 (2.0–19.3) 9.9 (3.2–23.2)	

Table 2.2.1 (contd)

Reference Study and years of study	Site ICD codes	Smoking category (cases or deaths)	Relative risk (95% CI)	Variables adjusted for/ comments
Shanks & Burns (1998) (contd)		No inhalation Slight inhalation Moderate and deep inhalation	6.9 (3.3–12.6) 5.0 (0.1–27.7) 15.5 (3.6–12.1)	
Iribarren *et al*. (1999) Kaiser Permanente Medical Care Program Study 1971–96	Oral cavity, pharynx	Never-smoker (39) Current cigar only (8) < 5 cigars/day (3) > 5 cigars/day (4)	1.0 2.6 (1.2–5.8) 1.3 (0.4–4.4) 7.2 (2.4–21.2)	Age, race, body-mass index, diabetes, alcohol, occupational exposures
	Oral cavity, pharynx, larynx, oesophagus	Never-smoker (57) Current cigar only (10) < 5 cigars/day (4) > 5 cigars/day (5)	1.0 2.0 (1.0–4.1) 1.1 (0.4–3.1) 5.2 (2.0–13.5)	
Shapiro *et al*. (2000) Cancer Prevention Study II 1982–94	Oral cavity, pharynx	Never-smoker (20) Former cigar only (4) Current cigar only (6) 1–2 cigars/day (0) > 3 cigars/day (6) < 25 years (0) ≥ 25 years (5) No inhalation (3) Inhalation (2)	1.0 2.4 (0.8–7.3) 4.0 (1.5–10.3) – 7.6 (2.9–19.6) – 4.6 (1.6–13.0) 3.2 (0.9–11.0) 6.5 (1.4–29.2)	Age, alcohol, use of smokeless tobacco
Pipe and cigar				
Doll & Peto (1976) British Doctors' Study 1951–71	Oral cavity (excluding nasopharynx), pharynx, larynx, trachea	Never-smoker Current pipe/cigar only	1.0 9.0	Age Includes former cigarette smokers
Chow *et al*. (1993) US Veterans' Study 1954–80	Nasopharynx	Never-smoker (5) Ever pipe/cigar only (2)	1.0 1.0 (0.2–5.2)	Age, year

Table 2.2.2. Case–control studies on exclusive pipe and/or cigar smoking and cancers of the oral cavity and pharynx

Reference Country and years of study	Study characteristics	Site ICD9 codes	Smoking category (cases/controls)	Relative risk (95% CI)	Variables adjusted for/ comments
Pipe only or cigar only					
Zheng *et al*. (1990) China 1988–89	248 cases (men) 248 hospital controls, age 18–80 years, response rate 100/100%	Oral cavity 141,143–145	Never-smoker (58/105) Ever pipe only (47/13) < 8 g tobacco/day 8–15.2 g tobacco/day > 15.2 g tobacco/day	1.0 5.7 (2.4–13.3) 3.5 (1.2–10.1) 4.9 (2.0–12.1) 6.3 (2.6–15.2)	Hospital, age, alcohol, education
	156 cases (women) 156 hospital controls	Oral cavity 141,143–145	Never-smoker (104/140) Ever pipe only (26/5)	1.0 4.9 (1.5–16.0)	
La Vecchia *et al*. (1998) Italy/Switzerland 1984–97	59 cases (men) 801 hospital controls, age < 75 years, response rate 98/97%	Oral cavity, pharynx, oesophagus [codes not given]	Never-smoker (50/788) Current cigar only (7/5) Ever cigar only (9/13) Ever > 3 cigars/day (4/5)	1.0 14.9 (4.0–55.9) 6.8 (2.5–18.5) 8.9 (2.1–36.9)	Age, alcohol, education Same study population as Franceschi *et al.* (1990) (see below)
	36 cases (men) 23 cases (men)	Oral cavity, pharynx Oesophagus	Ever cigar only Ever cigar only	9.0 (2.7–30.0) 4.1 (0.7–23.0)	
Pipe and cigar					
Blot *et al*. (1988) USA 1984–85	762 cases (men) 837 population controls, age 18–79 years, median 63; response rate 75/76%	Oral cavity, pharynx 141,143–146 148–149	Never-smoker (50/185) Ever pipe/cigar only (52/56) ≥ 40 cigars/week (14/1) ≥ 40 pipefuls/week (12/7)	1.0 1.9 (1.1–3.4) 16.7 (3.7–76.7) 3.1 (1.1–8.7)	Age, race, location, alcohol, respondent status (self/proxy)
Franceschi *et al*. (1990) Italy 1986–89	291 cases (men) 1272 hospital controls, age < 75 years, response rate 98/97%	Oral cavity 140–141, 143–145 Pharynx 146, 148, 161.1	Never-smoker (4/289) Ever pipe/cigar only (6/14) Never-smoker (2/289) Ever pipe/cigar only (0/2)	1.0 20.7 (5.6–76.3) –	Age, area

Table 2.2.2 (contd)

Reference Country and years of study	Study characteristics	Site ICD9 codes	Smoking category (cases/controls)	Relative risk (95% CI)	Variables adjusted for/ comments
Franceschi *et al*. (1992) Italy 1986–90	102 cases (men) 726 hospital controls 104 cases (men) age < 75 years, median 58, response rate 98/97%	Tongue 141 Mouth 143–145,149	Never-smoker (3/153) Current pipe/cigar only (1/6) Never-smoker (3/153) Current pipe/cigar only (5/6)	1.0 3.4 (0.3–39.1) 1.0 21.9 (3.8–125.6)	Age, area, occupation, alcohol Age, area, occupation, alcohol Same study population as as Franceschi *et al.* (1990) (see above)
Fernandez Garrote *et al*. (2001) Cuba 1996–99	200 cases (men/ women) 200 hospital controls, age 25–91 years, median 63; response rate 88/79%	Oral cavity, pharynx [codes not given]	Never-smoker (16/81) Current pipe/cigar only < 4 pipes/cigars/day (6/7) ≥ 4 pipes/cigars/day (11/3)	1.0 4.3 (1.1–16.4) 20.5 (4.7–89.7)	Age, sex, area, education, alcohol p for trend < 0.01

Table 2.2.3. Effect of interaction between pipe and/or cigar smoking and alcohol drinking on cancer of the oral cavity and pharynx

Reference Country and years of study	Study characteristics	Site ICD9 codes	Smoking/alcohol category (cases/deaths)	Relative risk (95% CI)	Variables adjusted for/comments
Pipe only or cigar only					
Iribarren *et al*. (1999) Kaiser Permanente Medical Care Program Study 1971–1996	17 774 men, 47 cases, age 30–85 years, median 46	Oral cavity, pharynx 140–149	Never-smoker/< 2 drinks/day (39) Never-smoker/> 3 drinks/day (1) Current cigar/< 2 drinks/day (4) Current cigar/> 3 drinks/day (4)	1.0 0.4 (0.1–2.8) 1.5 (0.5–4.3) 7.6 (2.7–21.6)	
Pipe and cigar					
Blot *et al*. (1988) USA 1984–85	762 cases (men) 837 population controls age 18–79 years, median 63	Oral cavity, pharynx 141, 143–146, 148–149	Never-smoker/< 1 drink/week Ever pipe/cigar/< 1 drink/week Ever pipe/cigar/1–4 drinks/week Ever pipe/cigar/5–14 drinks/week Ever pipe/cigar/15–29 drinks/week Ever pipe/cigar/≥ 30 drinks/week	1.0 0.6 1.0 3.7 4.7 23.0	Age, race, location, respondent status (self/ proxy)

Table 2.2.4. Cohort studies on exclusive pipe and/or cigar smoking and lung cancer

Reference Study and years of study	Smoking category (cases or deaths)	Relative risk (95% CI)	Variables adjusted for/comments
Pipe only or cigar only			
Hammond & Horn (1958) American Cancer Society (9-state) Study 1952–55	Never-smoker (15) Ever pipe only (18) Ever cigar only (7)	1.0 3.0 [1.5–6.0] 1.0 [0.4–2.5]	Age
Kahn (1966) US Veterans' Study 1954–62	Never-smoker (78) Former pipe only (7) Current pipe only (17) Former cigar only (5) Current cigar only (25)	1.0 2.4 [1.1–5.2] 1.8 [1.1–3.1] 1.0 [0.4–2.5] 1.6 [1.01–2.5]	Age
Carstensen *et al*. (1987) Swedish Census Study 1963–79	Never-smoker (23) Current pipe only (59) Current cigar only (11)	1.0 7.2 [4.4–11.7] 7.6 [3.7–15.6]	Age, residence; risk increased with grams of tobacco smoked per day.
Lange *et al*. (1992) Copenhagen City Heart Study 1976–89	Never-smoker (5) Current cigar/cheroot only (47) Current pipe only (16)	1.0 6.0 (2.2–17) 4.1 (1.4–13)	Men; age; 17% lung cancer deaths attributable to cigar/cheroot and pipe smoking
	Never-smoker (7) Current cigar/cheroot only (14)	1.0 4.9 (3.0–12)	Women; age; 10% lung cancer deaths attributable to cigar/cheroot smoking
Tverdal *et al*. (1993) Norwegian Screening Study 1973–88	Never-smoker (4) Current pipe only (19)	1.0 [13.0 (4.4–38.2)]	Age and area
Ben-Shlomo *et al*. (1994) Whitehall Study 1967–87	Never-smoker (24) Current pipe only (8) Current cigar only (1)	1.0 [4.0 (1.8–8.9)] [1.8 (0.2–13.3)]	Age
Wald & Watt (1997) BUPA Study 1975–93	Never-smoker (7) Current pipe/cigar only (6)	1.0 3.2 (1.1–9.5)	Age
Shanks & Burns (1998) CPS-I 1959–72	Never-smoker (191) Current cigar only (73) 1–2 cigars/day 3–4 cigars/day > 5 cigars/day No inhalation Slight inhalation Moderate and deep inhalation	1.0 2.1 (1.6–2.7) 0.9 (0.5–1.7) 2.4 (1.5–3.5) 3.4 (2.3–4.8) 2.0 (1.5–2.6) 1.9 (0.8–3.7) 4.9 (1.8–10.7)	Age

Table 2.2.4 (contd)

Reference Study and years of study	Smoking category (cases or deaths)	Relative risk (95% CI)	Variables adjusted for/comments
Iribarren *et al*. (1999) Kaiser Permanente Medical Care Program Study 1971–96	Never-smoker (54) Current cigar only (11) < 5 cigars/day (6) > 5 cigars/day (3)	1.0 2.1 (1.1–4.1) 1.6 (0.7–3.7) 3.2 (1.01–10.4)	Age, race, body-mass index, diabetes, alcohol, occupational exposures
Shapiro *et al*. (2000) CPS-II 1982–94	Never-smoker (269) Former cigar only (36) Current cigar only (88) 1–2 cigars/day (10) > 3 cigars/day (68) < 25 years (8) > 25 years (75) No inhalation (36) Inhalation (37)	1.0 1.6 (1.2–2.4) 5.1 (4.0–6.6) 1.3 (0.7–2.4) 7.8 (5.9–10.3) 2.1 (1.0–4.2) 5.9 (4.5–7.7) 3.3 (2.3–4.7) 11.3 (7.9–16.1)	Age, alcohol, smokeless tobacco
Pipe and cigar			
Doll & Peto (1976) British Doctors' Study 1951–71	Never-smoker Current pipe/cigar only	1.0 5.8	Age
Chow *et al*. (1992) Lutheran Brotherhood Insurance Study 1966–86	Never-smoker (6) Current pipe/cigar only (4) Former pipe/cigar only (1)	1.0 3.5 (1.0–12.6) 1.3 (0.2–10.5)	Age and occupation

Table 2.2.5. Case–control studies on exclusive pipe and/or cigar smoking and lung cancer

Reference Country and years of study	Study characteristics	Smoking category (cases/controls)	Relative risk (95% CI)	Variables adjusted for/comments
Pipe only or cigar only				
Lubin *et al.* (1984) 7 areas in Europe 1976–80	6920 cases (men) 13 460 hospital controls	Never-smoker (190/2616)	1.00	Age, study location, hospital
		Ever pipe only (39/197)	2.5 [1.8–3.7]	
		1–19 years (3/36)	1.1 [0.3–3.6]	
		20–29 years (3/43)	1.02 [0.3–3.3]	
		30–39 years (11/54)	2.5 [1.3–4.9]	
		≥ 40 years (22/64)	4.4 [2.7–7.4]	p for trend < 0.01
		1–3 pipes/day (14/49)	3.2 [1.8–6.0]	
		4–6 pipes/day (13/79)	2.2 [1.2–4.0]	
		≥ 7 pipes/day (12/68)	2.7 [1.4–5.1]	p for trend < 0.01
		Inhalation		
		Never inhaled	1.0	
		Moderately inhaled	1.3	
		Deeply inhaled	1.3	p for trend = 0.06 also adjusted for duration
		Current pipe only	1.0	
		1–4 years since quitting	2.0	
		> 5 years since quitting	0.9	p for trend = 0.33 also adjusted for duration
		Never-smoker (190/2616)	1.0	Age, study location, hospital
		Ever cigar only (37/145)	2.9 [2.0–4.3]	
		1–19 years (5/30)	2.4 [0.9–6.4]	
		20–29 years (10/29)	4.2 [2.0–8.8]	
		30–39 years (8/36)	2.4 [1.1–5.2]	
		≥ 40 years (14/50)	3.0 [1.6–5.5]	p trend < 0.01
		1–3 cigars/day (8/61)	1.6 [0.7–3.3]	
		4–6 cigars/day (12/59)	2.2 [1.2–4.1]	
		≥ 7 cigars/day (17/25)	8.9 [4.7–16.8]	p for trend < 0.01
		Inhalation		
		Never inhaled	1.0	
		Moderately inhaled	2.7	
		Deeply inhaled	9.5	p for trend < 0.01 also adjusted for duration
		Current cigar only	1.0	
		1–4 years since quitting	0.6	
		> 5 years since quitting	0.7	p-value for trend = 0.17 also adjusted for duration

Table 2.2.5 (contd)

Reference Country and years of study	Study characteristics	Smoking category (cases/controls)	Relative risk (95% CI)	Variables adjusted for/comments
Benhamou *et al*. (1986) France 1976–80	1529 cases (men) 2899 hospital controls [response rate not reported]	Never-smoker (36/650)	1.0	Age, hospital, interviewer
		Ever pipe only (5/56)	1.6 (0.5–4.5)	
		Inhalation		Same study population as Lubin *et al*. (1984)
		No inhalation (5/48)	1.9	
		Sometimes/rarely inhaled (0/6)	–	
		Usually/always inhaled (0/2)	–	
		Ever pipe only < 10 years (0/5)	1.0	
		Ever pipe only > 10 years (5/51)	1.17	
		Never-smoker (36/650)	1.0	Age, hospital, interviewer
		Ever cigar only (9/29)	5.6 (2.3–13.5)	
		Inhalation		
		No inhalation (6/28)	3.9	
		Sometimes/rarely inhaled (1/0)	–	
		Usually/always inhaled (2/1)	36.1	p for trend < 0.01
		Ever cigar only < 15 years (1/9)	1.0	
		Ever cigar only > 15 years (8/20)	3.6	
Damber & Larsson (1986) Sweden 1972–77	579 cases (men) 582 population controls (dead), response rate: 98/96%	Never-smoker (42/208)	1.0	Age; postal questionnaire — answered by relatives of cases and or controls; risk increased with years of smoking and decreased with years of cessation [odds ratios not given]
		Ever pipe only (198/142)	6.9 [4.5–10.5]	
		< 100 g/week	4.7	
		> 100 g/week	11.1	
		Ever cigar only (7/7)	[5.0 (1.5–16.8)]	
Qiao *et al*. (1989) China 1985	107 cases (men) 107 occupational controls, age 35–80 years, response rate: 100/100%	Never-smoker (3/5)	1.0	Age; participants were tin miners (1967–84); interviews with 10/6% proxy
		Ever water pipe only (24/23)	1.9 (0.4–9.4)	
Lubin *et al*. (1992) China 1984–88	544 cases (men) 1043 occupational and population controls, age 35–75 years, response rate: 92/91%	Never-smoker (9/72)	1.0	Age, type of control, proxy, years of work underground Smoking of water pipe or Chinese long-stem pipe (extension of Qiao *et al*., 1989)
		Ever pipe only (56/151)	1.8 (0.8–4.2)	
		1–150 g/month (18/41)	2.1 [0.9–5.1]	
		200 g/month (4/18)	2.6 [0.7–9.3]	
		250 g/month (25/44)	4.1 [1.8–9.6]	
		≥ 300 g/month (9/47)	1.3 [0.5–3.5]	
		1–29 years (7/21)	2.1 [0.7–6.3]	
		30–39 years (13/31)	2.7 [1.1–7.0]	
		40–49 years (24/70)	2.5 [1.1–5.8]	
		≥ 50 years (10/32)	2.1 [0.8–5.6]	

Table 2.2.5 (contd)

Reference Country and years of study	Study characteristics	Smoking category (cases/controls)	Relative risk (95% CI)	Variables adjusted for/comments
Boffetta *et al.* (1999) Germany, Italy, Sweden 1988–94	5621 cases (men) 7255 hospital controls, response rate 67/38% and above	**Pipe**		
		Nonsmoker (117/1750)	1.0	Age, study centre
		Ever pipe only (61/129)	7.9 (5.3–11.8)	
		< 20 years (3/33)	1.3 (0.4–4.5)	
		20.1–32 years (7/33)	3.4 (1.4–8.0)	
		32.1–44 years (21/33)	13.3 (7.2–24.9)	
		≥ 44.1 years (30/30)	19.1 (10.4–35.1)	*p* for trend < 0.0001
		< 3.5 g/day (2/10)	2.2 (0.5–10.4)	
		3.6–5.0 g/day (22/54)	7.9 (4.3–14.3)	
		5.1–10.7 g/day (6/18)	4.8 (1.9–12.6)	
		≥ 10.8 g/day (31/47)	12.4 (7.2–21.4)	*p* for trend = 0.1
		Age at start < 20 (27/48)	9.6 (5.6–16.7)	
		Age at start 20–26 (20/52)	6.3 (3.5–11.2)	
		Age at start ≥ 27 (14/29)	8.2 (4.1–16.3)	*p* for trend = 0.4
		Nonsmoker (117/1750)	1.0	Age, study centre
		Current pipe only	12.5 (7.7–20.2)	
		Former, quit 1–14 years ago	10.3 (5.1–20.5)	
		Former, quit > 15 years ago	1.4 (0.5–4.0)	
		Cigar/cigarillo		
		Nonsmoker (117/1750)	1.0	Age, study centre
		Ever cigar only (16/42)	5.6 (2.9–10.6)	
		Ever cigarillo only (21/31)	12.7 (6.9–23.7)	
		Ever cigar/cigarillo only (43/77)	9.0 (5.8–14.1)	
		< 13 years (4/21)	3.1 (1.0–9.4)	
		13.1–26 years (5/20)	4.3 (1.6–11.9)	
		26.1–39 years (12/17)	10.3 (4.7–22.7)	
		> 39.1 years (22/19)	20.7 (10.5–41.1)	*p* for trend = 0.0003
		< 5 g/day (5/22)	3.4 (1.3–9.5)	
		5.1–12 g/day (10/25)	6.2 (2.8–13.7)	
		12.1–15 g/day (5/11)	7.8 (2.6–23.4)	
		≥ 15.1 g/day (23/19)	21.1 (10.7–41.7)	*p* for trend = 0.01
		Age at start < 20 (20/20)	17.0 (8.6–33.4)	
		Age at start 20–26 (16/23)	10.5 (5.3–21.1)	
		Age at start > 27 (7/34)	3.4 (1.5–8.0)	*p* for trend = 0.002
		Inhalation		
		Non-inhaler	5.2 (2.7–10.0)	
		Inhaler	28.1 [9.5–83.6]	
		Nonsmoker (117/1750)	1.0	Age, study centre
		Current cigar/cigarillo only	10.6 (5.9–19.1)	
		Former, quit 1–14 years ago	8.8 (4.0–19.5)	
		Former, quit > 15 years ago	6.9 (3.1–15.1)	

Table 2.2.6. Studies on exclusive pipe and/or cigar smoking and cancer of the larynx

Reference Study and years of study	Smoking category (cases or deaths)	Relative risk (95% CI)	Variables adjusted for/ comments
Pipe only or cigar only			
Kahn (1966)	Never-smoker (3)	1.0	Age
US Veterans'	Former pipe only (0)	–	
Study	Current pipe only (0)	–	
1954–62	Former cigar only (0)	–	
	Current cigar only (6)	10.3 [2.6–41.3]	
Shanks & Burns	Never-smoker (4)	1.0	Age
(1998)	Current cigar only (7)	10.0 (4.0–20.6)	
CPS-I	1–2 cigars/day	6.5 (0.7–23.3)	
1959–72	3–4 cigars/day	–	
	> 5 cigars/day	26.0 (8.4–60.7)	
	No inhalation	10.6 (3.9–23.1)	
	Slight inhalation	–	
	Moderate and deep inhalation	53.3 (0.7–296.3)	
Shapiro *et al.*	Never-smoker (5)	1.0	Age, alcohol, smokeless
(2000)	Former cigar only (3)	6.7 (1.5–30.0)	tobacco use; excludes
CPS-II	Current cigar only (4)	10.3 (2.6–41.0)	cancer at baseline
1982–94	1–2 cigars/day (1)	6.0 (0.7–53.5)	
	> 3 cigars/day (3)	15.0 (3.4–65.9)	
	< 25 years (0)	–	
	> 25 years (4)	13.7 (3.4–54.5)	
	No inhalation (1)	4.2 (0.5–37.1)	
	Inhalation (3)	39.0 (8.4–180.1)	

Table 2.2.7. Case–control study on exclusive pipe and/or cigar smoking and cancer of the larynx

Reference Country and years of study	Study characteristics	Smoking category (cases/controls)	Relative risk (95% CI)	Variables adjusted for/ comments
Pipe and cigar				
Franceschi *et al*. (1990) Italy 1986–89	162 cases (men) 1272 hospital controls age < 75 years, response rate 98/97%	Never-smoker (8/289) Ever pipe/cigar only (1/14)	1.0 2.8 (0.3–26.1)	Age, area

Table 2.2.8. Cohort studies on exclusive pipe and/or cigar smoking and cancers of the oesophagus and stomach

Reference Name of study and years of study	Site	Smoking category (cases or deaths)	Relative risk (95% CI)	Variables adjusted for/comments
Pipe only or cigar only				
Hammond & Horn (1958) American Cancer Society (9-state) Study 1952–55	Stomach, pancreas, liver, colorectum	Never-smoker (100) Ever pipe only (41) Ever cigar only (63)	1.0 1.0 [0.7–1.4] 1.4 [1.1–1.8]	Age
Kahn (1966) US Veterans' Study 1954–62	Oesophagus	Never-smoker (11) Former pipe only (0) Current pipe only (3) Former cigar only (2) Current cigar only (12)	1.0 – 2.0 [0.6–7.1] 2.4 [0.5–10.9] 5.3 [2.4–12.1]	Age
	Stomach	Never-smoker (96) Former pipe only (4) Current pipe only (16 Former cigar only (8) Current cigar only (23)	1.0 1.1 [0.4–3.0] 1.4 [0.8–2.4] 1.3 [0.6–2.7] 1.2 [0.8–1.9]	
Carstensen *et al*. (1987) Swedish Census Study 1963–79	Oesophagus	Never smoker (5) Current pipe only (6) Current cigar only (2)	1.0 3.6 [1.1–11.8] 6.5 [1.3–33.5]	Age, residence
Tverdal *et al*. (1993) Norwegian Screening Study 1973–88	Stomach	Never-smoker (8) Current pipe only (4)	1.0 [1.5 (0.5–5.1)]	Age and area
Shanks & Burns (1998) CPS-I 1959–72	Oesophagus	Never-smoker (30) Current cigar only (19) 1–2 cigars/day 3–4 cigars/day > 5 cigars/day No inhalation Slight inhalation Moderate and deep inhalation	1.0 3.6 (2.2–5.6) 2.3 (0.7–5.3) 3.9 (1.4–8.6) 5.2 (2.2–10.2) 3.4 (1.9–5.6) 1.9 (0.0–10.6) 14.8 (3.0–43.5)	Age
Shapiro *et al*. (2000) CPS-II 1982–94	Oesophagus	Never-smoker (67) Former cigar only (8) Current cigar only (9) 1–2 cigars/day (4) > 3 cigars/day (5) < 25 years (1) > 25 years (8) No inhalation (5) Inhalation (1)	1.0 1.3 (0.6–2.8) 1.8 (0.9–3.7) 1.8 (0.6–5.0) 1.9 (0.8–4.9) 0.9 (0.1–6.4) 2.2 (1.0–4.7) 1.6 (0.7–4.1) 1.0 (0.1–7.2)	Age, alcohol, smokeless tobacco use

Table 2.2.8 (contd)

Reference Name of study and years of study	Site	Smoking category (cases or deaths)	Relative risk (95% CI)	Variables adjusted for/comments
Chao *et al*. (2002) CPS-II 1982–96	Stomach	Never-smoker Former cigar only (13) Current cigar only (25) 1–4 cigars/day (13) ≥ 5 cigars/day (12) < 39 years of smoking (13) ≥ 40 years of smoking (10) Age at starting ≥ 30 years (5) 20–29 years (12) ≤ 19 years (6) No inhalation (15) Inhalation (8) Former pipe only (6) Current pipe only (16)	1.0 1.3 (0.7–2.2) 2.3 (1.5–3.5) 1.7 (0.95–3.0) 4.2 (2.3–7.6) 2.4 (1.4–4.3) 2.6 (1.3–4.9) 1.6 (0.7–4.0) 2.9 (1.6–5.2) 2.4 (1.1–5.6) 2.1 (1.2–3.6) 3.9 (1.9–8.0) 0.7 (0.3–1.6) 1.3 (0.8–2.2)	Age, race, education, family history of stomach cancer, use of aspirin and several dietary habits
Pipe and cigar				
Doll & Peto (1976) British Doctors' Study 1951–71	Oesophagus	Never-smoker Current pipe/cigar only	1.0 3.7	Age
Kneller *et al*. (1991) Lutheran Brotherhood Insurance Study 1966–86	Stomach	Never-smoker (8) Tobacco but never cigarettes (6)	1.0 1.5 (0.5–4.4)	Age

Table 2.2.9. Case–control studies on exclusive pipe and/or cigar smoking and cancers of the oesophagus and stomach

Reference Country and years of study	Study characteristics	Site	Smoking category (cases/controls)	Relative risk (95% CI)	Variables adjusted for/comments
Pipe only or cigar only					
La Vecchia *et al*. (1998) Italy/Switzerland 1984–97	23 cases (men) 801 hospital controls age < 75 years; response rate 98/97%	Oesophagus	Never-smoker (50/788) Ever cigar only	1.0 4.1 (0.7–23.0)	Age, alcohol consumption, education Same study population as Franceschi *et al*. (1990) below
Pipe and cigar					
Wu-Williams *et al*. (1990) USA 1975–82	137 cases (white men) 137 population controls, mean age 47 years, response rate 52% (matched design)	Stomach	Never-smoker (21/35) Ever pipe/cigar only (3/3)	1.0 1.8 (0.3–9.8)	Age, race, area
Franceschi *et al*. (1990) Italy 1986–89	288 cases (men) 1272 hospital controls age < 75 years, response rate 98/97%	Oesophagus	Never-smoker (17/289) Ever pipe/cigar only (7/14)	1.0 6.3 (2.3–19.8)	Age, area
Kabat *et al*. (1993) USA 1981–90	431 cases (white men) 4544 hospital controls [response rate not reported]	SCCE AEC ADS	Never-smoker (15/1054) Ever pipe/cigar only (11/332) Never-smoker (25/1054) Ever pipe/cigar only (9/332) Never-smoker (23/1054) Ever pipe/cigar only (8/332)	1.0 1.8 (0.8–4.1) 1.0 1.1 (0.5–2.3) 1.0 1.0 (0.4–2.2)	Age, hospital, time period, education, alcohol consumption

SCCE, squamous-cell carcinoma of the oesophagus; AEC, adenocarcinoma of the oesophagus or cardia; ADS, adenocarcinoma of the distal stomach

Table 2.2.10. Cohort studies on exclusive pipe and/or cigar smoking and colorectal cancer

Reference Name of study and years of study	Site ICD code	Smoking category (cases or deaths)	Relative risk (95% CI)	Variables adjusted for/comments
Pipe only or cigar only				
Tverdal *et al*. (1993)	Colon	Never-smoker (9)	1.0	Age and area
Norwegian Screening		Current pipe only (3)	[0.9 (0.2–3.2)]	
Study	Rectum	Never-smoker (7)	1.0	
1973–88		Current pipe only (4)	[1.6 (0.5–5.5)]	
Heineman *et al*. (1995)	Colon	Never-smoker (782)	1.0	Age, calendar year, year of survey,
US Veterans' Study		Current pipe/cigar only (576)	1.3 (1.1–1.4)	socioeconomic status, sedentary job
1954–80		Current pipe < 5/day (22)	1.2 (0.8–1.9)	
		Current pipe 5–9/day (27)	1.2 (0.8–1.7)	
		Current pipe 10–19/day (11)	0.7 (0.4–1.2)	
		Current pipe > 20/day (15)	1.8 (1.1–2.9)	*p* for trend = 0.30
		Current cigar 1–2/day (50)	1.5 (1.1–1.9)	
		Current cigar 3–4/day (34)	0.9 (0.6–1.3)	
		Current cigar 5–8/day (44)	1.4 (1.1–1.9)	
		Current cigar > 9/day (15)	2.2 (1.3–3.7)	*p* for trend = 0.004
	Ascending	Never-smoker (67)	1.0	
	153.0	Current pipe/cigar only (48)	1.2 (0.8–1.7)	
	Transverse	Never-smoker (15)	1.0	
	153.1	Current pipe/cigar only (7)	0.8 (0.3–2.0)	
	Descending	Never-smoker (15)	1.0	
	153.2	Current pipe/cigar only (5)	0.6 (0.2–1.6)	
	Sigmoid	Never-smoker (67)	1.0	
	153.3	Current pipe/cigar only (54)	1.4 (1.0–2.0)	
	Rectum	Never-smoker (201)	1.0	
		Current pipe/cigar only (169)	1.4 (1.2–1.8)	
		Current pipe < 5/day (3)	0.6 (0.2–2.0)	
		Current pipe 5–9/day (11)	1.9 (1.0–3.5)	
		Current pipe 10–19/day (10)	2.3 (1.2–4.4)	
		Current pipe > 20/day (4)	1.8 (0.7–4.8)	*p* for trend = 0.007
		Current cigar 1–2/day (14)	1.6 (0.9–2.7)	
		Current cigar 3–4/day (13)	1.4 (0.8–2.4)	
		Current cigar 5–8/day (13)	1.6 (0.9–2.9)	
		Current cigar > 9/day (1)	0.6 (0.1–4.2)	*p* for trend = 0.12

Table 2.2.10 (contd)

Reference Name of study and years of study	Site ICD code	Smoking category (cases or deaths)	Relative risk (95% CI)	Variables adjusted for/comments
Iribarren *et al*. (1999) Kaiser Permanente Medical Care Program Study 1971–96	Colon and rectum	Never-smoker (332) Current cigar only (39)	1.0 1.1 (0.8–1.6)	Age, race, body-mass index, diabetes, alcohol, occupational exposure; excludes cancer of interest at baseline
Pipe and cigar				
Doll & Peto (1976) British Doctors' Study 1951–71	Rectum	Never-smoker Current pipe/cigar only	1.0 1.7	Age
Hsing *et al*. (1998) Lutheran Brotherhood Insurance Study 1966–86	Colon Colon and rectum	Never-smoker (16) Ever pipe/cigar only (16) Never-smoker (26) Ever pipe/cigar only (17)	1.0 1.6 (0.8–3.2) 1.0 1.0 (0.5–1.9)	Age, urban/rural, alcohol
Knekt *et al*. (1998) Finnish Mobile Clinic Health Examination Study 1966–94	Colon and rectum Colon Rectum	Never-smoker (264) Current pipe/cigar only (14) Never-smoker (144) Current pipe/cigar only (6) Never-smoker (120) Current pipe/cigar only (8)	1.0 1.5 (0.8–2.6) 1.0 1.5 (0.6–3.5) 1.0 1.5 (0.7–3.1)	Age, sex, body-mass index, area, occupation, marital status
Chao *et al*. (2000) CPS-II 1982–96	Colon and rectum	Never-smoker (2156) Current pipe/cigar only ≥ 20 years	1.0 1.3 (1.1–1.6)	Age, race, body-mass index, education, exercise, intake of aspirin, multivitamins, alcohol, fibre, vegetables and fatty meats, and family history of colorectal cancer

Table 2.2.11. Cohort studies on exclusive pipe and/or cigar smoking and cancer of the liver and intrahepatic bile ducts

Reference Name of study and years of study	Smoking category (cases or deaths)	Relative risk (95% CI)	Variables adjusted for/ comments
Pipe only or cigar only			
Carstensen *et al.* (1987) Swedish Census Study 1963–79	Never-smoker (9) Current pipe only (5) Current cigar only (4)	1.0 1.7 [0.6–5.1] 7.2 [2.2–23.4]	Age, residence
Hsing *et al*. (1990a) US Veterans' Study 1954–80	Nonsmoker (37) Current cigar/pipe smoker (47)	1.0 3.1 (2.0–4.8)	Age, year

Table 2.2.12. Case–control study on exclusive pipe and/or cigar smoking and cancer of the gallbladder and extrahepatic bile ducts

Reference Country and years of study	Study characteristics	Site	Smoking category (cases/controls)	Relative risk (95% CI)	Variables adjusted for/ comments
Pipe and cigar					
Chow *et al.* (1994) USA 1985–89	49 cases (white men) 97 population controls; age, 30–84 years; response rate: 76/84%	Extrahepatic bile duct	Never-smoker (6/25) Ever pipe/cigar only (2/7)	1.0 1.6 (0.3–9.9)	Adjusted for age and ethnicity (58% proxy for deceased cases)
		Ampulla of Vater	Never-smoker (1/25) Ever pipe/cigar only (2/7)	1.0 7.6 (0.6–100.4)	

Table 2.2.13. Cohort studies on exclusive pipe and/or cigar smoking and cancer of the pancreas

Reference Name of study and years of study	Smoking category (cases or deaths)	Relative risk (95% CI)	Variables adjusted for/ comments
Pipe only or cigar only			
Kahn (1966) US Veterans' Study 1954–62	Never-smoker (88) Former pipe only (2) Current pipe only (8) Former cigar only (5) Current cigar only (27)	1.0 0.6 [0.2–2.4] 0.7 [0.4–1.5] 0.9 [0.4–2.1] 1.5 [0.99–2.3]	Age
Carstensen *et al*. (1987) Swedish Census Study 1963–79	Never-smoker (20) Current pipe only (19) Current cigar only (1)	1.0 2.8 [1.5–5.2] 1.0 [0.1–7.5]	Age, residence
Tverdal *et al*. (1993) Norwegian Screening Study 1973–88	Never-smoker (5) Current pipe only (2)	1.0 [1.2 (0.2–6.2)]	Age and area
Shanks & Burns (1998) CPS-I 1959–72	Never-smoker (198) Current cigar only (56) 1–2 cigars/day 3–4 cigars/day > 5 cigars/day No inhalation Slight inhalation Moderate and deep inhalation	1.0 1.6 (1.2–2.1) 1.2 (0.7–1.9) 1.5 (0.9–2.5) 2.2 (1.4–3.2) 1.6 (1.1–2.1) 2.2 (0.99–4.1) 2.3 (0.5–6.6)	Age
Iribarren *et al*. (1999) Kaiser Permanente Medical Care Program Study 1971–96	Never-smoker (46) Current cigar only (6)	1.0 1.2 (0.5–2.9)	Age, race, body-mass index, diabetes, alcohol, occupational exposures
Shapiro *et al*. (2000) CPS-II 1982–94	Never-smoker (327) Former cigar only (30) Current cigar only (28) 1–2 cigars/day (6) > 3 cigars/day (18) < 25 years (7) > 25 years (19) No inhalation (12) Inhalation (12)	1.0 1.1 (0.7–1.6) 1.3 (0.9–1.9) 0.6 (0.3–1.4) 1.6 (1.0–2.5) 1.5 (0.7–3.3) 1.1 (0.7–1.8) 0.9 (0.5–1.5) 2.7 (1.5–4.8)	Age, alcohol, smokeless tobacco use
Pipe and cigar			
Doll & Peto (1976) British Doctors' Study 1951–71	Never-smoker Current pipe/cigar only	1.0 0.9	Age
Zheng *et al*. (1993) Lutheran Brotherhood Insurance Study 1966–86	Never-smoker (9) Ever pipe/cigar only (5)	1.0 0.8 (0.3–2.5)	Age, alcohol

Table 2.2.14. Case–control studies on exclusive pipe and/or cigar smoking and cancer of the pancreas

Reference Country and years of study	Study characteristics	Smoking category (cases/controls)	Relative risk (95% CI)	Variables adjusted for/comments
Pipe only or cigar only				
Muscat *et al*. (1997) USA 1985–93	290 cases (men) 572 hospital controls mean age 61 years; response rate 51/63%	Never-smoker (66/157) Ever pipe/cigar only (25/28) Nonsmoker (146/334) Ever pipe only (16/20) 1–20 years (6/7) > 20 years (10/13) 1–5 pipes/day (7/10) > 5 pipes/day (9/10) Nonsmoker (146/334) Ever cigar only (15/12) 1–20 years (7/4) > 20 years (8/7) 1–4 cigars/day (8/11) > 4 cigars/day (7/1)	1.0 2.1 (1.2–3.8) 1.0 1.8 (0.9–5.3) 1.8 (0.6–5.3) 1.6 (0.7–3.7) 1.4 (0.5–3.8) 1.4 (0.9–2.2) 1.0 3.1 (1.4–6.9) 3.9 (1.2–13.6) 2.2 (0.8–7.3) 1.4 (0.6–3.6) 14.1 (1.7–115.7)	Age, education; trained interviewer Age, education; referent includes long-term quitters (> 20 years) Age, education; referent includes long-term quitters (> 20 years)
Pipe and cigar				
Mack *et al*. (1986) USA 1976–81	490 cases (men/women) 490 population controls age < 65 years response rate 68/76%	Never-smoker (97/154) Ever pipe/cigar only (7/13)	1.0 0.9 (0.3–2.3)	Age, sex, race, neighbourhood
Partanen *et al*. (1997) Finland 1984–87	625 cases (men/women) 1700 hospital controls age 40–74 years [response rates not reported]	Never-smoker Ever pipe/cigar only Former pipe/cigar only Current pipe/cigar only *Interaction with alcohol* Never smoker/never drinker Never smoker/moderate drinker Never smoker/heavy drinker Ever pipe/cigar/never drinker Ever pipe/cigar/moderate drinker Ever pipe/cigar/heavy drinker	1.0 2.3 (1.3–4.4) 1.3 (0.8–2.0) 2.6 (1.4–4.9) 1.0 1.1 (0.7–1.6) 0.8 (0.2–3.0) 2.2 (0.8–6.0) 2.2 (0.8–6.0) 2.2 (0.4–12.2)	Adjusted for age and sex; smoking status in 1960; former smokers were those who had quitted before interview. Adjusted for age and sex

Table 2.2.15. Cohort studies on exclusive pipe and/or cigar smoking and cancer of the bladder and kidney

Reference Name of study and years of study	Site	Smoking category (cases or deaths)	Relative risk (95% CI)	Variables adjusted for/ comments
Pipe only or cigar only				
Hammond & Horn (1958) American Cancer Society (9-State) Study 1952–55	Bladder, kidney, prostate	Never-smoker (38) Ever pipe only (21) Ever cigar only (19)	1.0 1.2 [0.7–2.0] 1.1 [0.6–1.8]	Age
Kahn (1966) US Veterans' Study 1954–62	Bladder	Never-smoker (52) Former pipe only (1) Current pipe only (8) Former cigar only (4) Current cigar only (10)	1.0 0.5 [0.1–3.5] 1.2 [0.6–2.5] 1.1 [0.4–3.0] 0.9 [0.5–1.9]	Age
	Kidney	Never-smoker (39) Former pipe only (1) Current pipe only (6) Former cigar only (2) Current cigar only (6)	1.0 0.7 [0.1–5.0] 1.3 [0.6–3.1] 0.8 [0.2–3.5] 0.8 [0.3–1.8]	
Carstensen *et al*. (1987) Swedish Census Study 1963–79	Bladder	Never-smoker (11) Current pipe only (16) Current cigar only (1)	1.0 4.0 [1.9–8.6] 1.9 [0.2–14.7]	Age, residence
Shanks & Burns (1998) CPS-I 1959–72	Bladder	Never-smoker (102) Current cigar only (25) 1–2 cigars/day 3–4 cigars/day > 5 cigars/day No inhalation Slight inhalation Moderate and deep inhalation	1.0 1.4 (0.9–2.0) 0.8 (0.3–1.7) 1.7 (0.8–3.2) 2.0 (0.97–3.7) 1.6 (1.00–2.4) – 1.5 (0.0–8.4)	Age
Iribarren *et al*. (1999) Kaiser Permanente Medical Care Program Study 1971–96	Bladder	Never-smoker (99) Current cigar only (10)	1.0 1.1 (0.6–2.0)	Age, race, body-mass index, diabetes, alcohol, occupational exposures
	Kidney	Never-smoker (50) Current cigar only (5)	1.0 1.1 (0.4–2.7)	
Shapiro *et al*. (2000) CPS-II, 1982–94	Bladder	Never-smoker (94) Former cigar only (10) Current cigar only (6) 1–2 cigars/day (0) > 3 cigars/day (6) < 25 years (0) > 25 years (5) No inhalation (2) Inhalation (4)	1.0 1.3 (0.7–2.5) 1.0 (0.4–2.3) – 1.9 (0.8–4.4) – 1.1 (0.4–2.7) 0.5 (0.1–2.1) 3.6 (1.3–9.9)	Age, alcohol, smokeless tobacco use

Table 2.2.15 (contd)

Reference Name of study and years of study	Site	Smoking category (cases or deaths)	Relative risk (95% CI)	Variables adjusted for/ comments
Pipe and cigar				
Doll & Peto (1976) British Doctors' Study 1951–71	Bladder	Never-smoker Current pipe/cigar only	1.0 1.6	Age
Steineck *et al*. (1988) Swedish Twin Registry Study 1967–82	Bladder	Never-smoker (8) Ever pipe/cigar only (16)	1.0 3.3 (1.5–7.4)	Age

Table 2.2.16. Case–control studies on exclusive pipe and/or cigar smoking and cancer of the bladder and kidney

Reference Country and years of study	Study characteristics	Site	Smoking category (cases/controls)	Relative risk (95% CI)	Variables adjusted for/comments
Pipe only or cigar only					
Jensen *et al*. (1987) Denmark 1979–81	389 cases (men/ women), 787 population controls, response rate 94/75%	Bladder	Never-smoker (26/132) Ever pipe only (6/18) Ever cigar only (1/2) Ever cigarillo only (8/39) Ever mixed only (18/55)	1.0 1.9 (0.7–5.4) 2.5 (0.2–28.4) 1.0 (0.4–2.4) 1.9 (0.9–3.8)	Age, sex; mixed includes pipe, cigar and cigarillo combined; study included in Pitard *et al*. (2001)
Jensen *et al*. (1988) Denmark 1979–82	96 cases (men/women) 288 hospital controls age < 80 years, response rate 99/100%	Renal pelvis, ureter	Never-smoker (8/57) Ever pipe only (1/10) Ever cigar only (4/24) Ever pipe/cigar only (3/7)	1.0 2.2 (0.1–97) 1.3 (0.3–6.1) 6.5 (0.4–21.2)	Age, sex
McLaughlin *et al*. (1995) Australia, Europe, USA 1989–91	1774 cases 2359 controls age 20–79 years; response rate 72/75%	Renal cell	Never-smoker (585/846) Ever cigar only (18/34) Ever pipe only (19/29)	1.0 0.8 (0.4–1.4) 0.9 (0.5–1.7)	Age, sex, centre, body-mass index
Pitard *et al*. (2001) Europe 1980–95	2279 cases (men) 5268 controls age < 80 years Pooled analysis	Bladder	Never-smoker (154/1109) Ever pipe only (28/85) 1–39 years (11/52) > 40 years (16/33) Ever cigar only (50/122) 1–29 years (15/62) 30–39 years (12/28) > 40 years (22/32) 0.1–1.5 cigars/day (4/23) > 1.5 cigars/day (8/34) Ever pipe/cigar only (10/46)	1.0 1.9 (1.2–3.1) 1.4 (0.7–2.8) 2.5 (1.3–4.9) 2.3 (1.6–3.5) 1.4 (0.8–2.6) 2.7 (1.3–5.7) 3.8 (2.1–7.1) 1.3 (0.4–4.0) 1.9 (0.8–4.4) 1.3 (0.6–2.6)	Age, centre, occupational exposures *p* for trend = 0.006 *p* for trend < 0.001 *p* for trend = 0.1

Table 2.2.17. Cohort studies on exclusive pipe and/or cigar smoking and prostate cancer

Reference Name of study and years of study	Smoking category (cases or deaths)	Relative risk (95% CI)	Variables adjusted for/comments
Pipe only or cigar only			
Kahn (1966) US Veterans' Study 1954–62	Never-smoker (117) Former pipe only (5) Current pipe only (23) Former cigar only (11) Current cigar only (36)	1.0 1.1 [0.4–2.6] 1.5 [0.98–2.4] 1.3 [0.7–2.5] 1.5 [1.03–2.2]	Age
Tverdal *et al*. (1993) Norwegian Screening Study 1973–88	Never-smoker (4) Current pipe only (1)	1.0 [0.7 (0.1–5.9)]	Age and area
Pipe and cigar			
Hsing *et al*. (1990b) Lutheran Brotherhood Insurance Study 1966–86	Never-smoker (19) Ever pipe/cigar only (9)	1.0 1.6 (0.7–3.5)	Age
Hsing *et al*. (1991) US Veterans' Study 1954–80	Never-smoker (1075) Current pipe/cigar only (497)	1.0 1.1 (0.99–1.2)	Age

Table 2.2.18. Case–control study on exclusive pipe and/or cigar smoking and prostate cancer

Reference Country and years of study	Study characteristics	Smoking category (cases/controls)	Relative risk (95% CI)	Variables adjusted for/ comments
Pipe and cigar				
Sharpe & Siemiatycki (2001) Canada 1979–85	399 cases (men) 476 population controls, age 45–70 years, response rate 81/72%	Never-smoker (47/76) Ever pipe only (6/6) Ever cigar only (6/7)	1.0 1.2 (0.4–4.1) 1.3 (0.4–4.5)	Age, ethnicity, respondent status, body-mass index, income, alcohol consumption

Table 2.2.19. Cohort studies on exclusive pipe and/or cigar smoking and cancer of the haematopoietic system

Reference Name of study and years of study	Site	Smoking category (cases or deaths)	Relative risk (95% CI)	Variables adjusted for/comments
Pipe only or cigar only				
Hammond & Horn (1958) American Cancer Society (9-state) Study 1952–55	Lymphoma, leukaemia	Never-smoker (31) Ever pipe only (15) Ever cigar only (10)	1.0 1.3 [0.7–2.3] 0.7 [0.4–1.5]	Age
Kinlen & Rogot (1988) US Veterans' Study 1954–69	Lymphatic leukaemia	Never-smoker (41) Ever pipe only (3) Ever cigar only (11)	1.0 0.8 (0.2–2.4) 2.0 (1.0–3.6)	Age
	Monocytic myeloid leukaemia	Never-smoker (60) Ever pipe only (6) Ever cigar only (14)	1.0 1.2 (0.4–2.6) 1.8 (1.0–3.0)	
	Acute leukaemia	Never-smoker (40) Ever pipe only (3) Ever cigar only (8)	1.0 0.9 (0.2–2.5) 1.5 (0.7–3.0)	
Heineman *et al*. (1992) US Veterans' Study 1954–80	Multiple myeloma	Never-smoker (141) Ever pipe/cigar only (95) Ever pipe only < 5 pipes/day (6) 5–9 pipes/day (2) 10–19 pipes/day (3) > 20 pipes/day (1) Ever cigar only 1–2 cigars/day (8) 3–4 cigars/day (8) 5–8 cigars/day (2) > 9 cigars/day (2)	1.0 1.2 (0.9–1.5) 1.9 0.5 1.0 0.6 1.3 1.2 0.4 1.7	Age, calendar year, year of response
Tverdal *et al*. (1993) Norwegian Screening Study 1973–88	Leukaemia	Never-smoker (6) Current pipe only (3)	1.0 [1.5 (0.4–5.9)]	Age and area

Table 2.2.19 (contd)

Reference Name of study and years of study	Site	Smoking category (cases or deaths)	Relative risk (95% CI)	Variables adjusted for/comments
Pipe and cigar				
Garfinkel & Boffetta (1990) CPS-I, 1959–65	Lymphatic leukaemia	Never-smoker	1.0	Age, men only
		Ever pipe/cigar only	1.1	
	Myeloid leukaemia	Never-smoker	1.0	
		Ever pipe/cigar only	1.5	
CPS-II, 1982–86	Lymphatic leukaemia	Never-smoker	1.0	
		Ever pipe/cigar only	1.2	
	Myeloid leukaemia	Never-smoker	1.0	
		Ever pipe/cigar only	0.9	

Table 2.2.20. Case–control studies on exclusive pipe and/or cigar smoking and cancers of the haematopoietic system

Reference Country and years of study	Study characteristics	Site	Smoking category (cases/controls)	Relative risk (95% CI)	Variables adjusted for/ comments
Pipe and cigar					
Kabat *et al*. (1988) USA 1969–85	342 cases (men) 5862 hospital controls age 20–80 years, mean 51 years; response rate 95/95%	Leukaemia	Never-smoker (94/1320) Ever pipe/cigar only (23/416)	1.0 0.78 (0.49–1.24)	Not adjusted; relative risk for non-cancer controls
Brown *et al*. (1992a) USA 1981–84	578 cases (white men) 820 population controls age > 30 years; response rate 86/78%	Acute non-lymphocytic leukaemia Chronic myelogenous leukaemia Chronic lymphocytic leukaemia Acute lymphocytic leukaemia	Never-smoker (29/197) Ever pipe/cigar only (4/40) Never-smoker (8/197) Ever pipe/cigar only (1/40) Never-smoker (40/197) Ever pipe/cigar only (13/40) Never-smoker (5/197) Ever pipe/cigar only (1/40)	1.0 0.7 (0.2–2.1) 1.0 0.6 (0.1–5.1) 1.0 1.6 (0.8–3.2) 1.0 0.8 (0.1–7.2)	Age, state, alcohol
Brown *et al*. (1992b) USA 1981–84	622 cases (white men) 820 population controls; age > 30 years; response rate 89/78%	Non-Hodgkin lymphoma	Never-smoker (116/197) Ever pipe/cigar only (29/40)	1.0 1.2 (0.8–2.1)	Age, state
	173 cases (white men) 452 population controls; age > 30 years; response rate 84/78%	Multiple myeloma	Never-smoker (41/105) Ever pipe/cigar only (6/22)	1.0 0.6 (0.2–1.6)	Age

Table 2.2.21. Cohort study on exclusive pipe and/or cigar smoking and brain cancer

Reference Name of study and years of study	Smoking category (cases or deaths)	Relative risk (95% CI)	Variables adjusted for/comments
Tverdal *et al.* (1993) Norwegian Screening Study 1973–88	Never-smoker (11) Current pipe only (2)	1.0 [0.5 (0.1–2.5)]	Age and area

Table 2.2.22. Case–control studies on bidi and other tobacco smoking and cancer of the oral cavity and pharynx

Reference Country and years of study	Cancer site (ICD-9)	No. of cases	No. of controls	Smoking category	Relative risk (95% CI)	Comments
Oral cavity						
Sankaranarayanan *et al*. (1989a) India 1983–84	Gingiva (143.0, 143.1)	54	402	*No. of bidis/day* Never-smoker	1.0	Hospital-based; as very few women smoked, only men were analysed.
		26	64	≤ 10	2.8 (1.6–4.8)	
		15	55	11–20	1.9 (1.0–3.6)	
		8	20	≥ 21	3.2 (1.3–7.7)	*p* for trend < 0.001
				Age at starting (years)		
		39	62	< 21	1.0	
		10	79	≥ 21	0.2 (0.1–0.4)	*p* for trend < 0.001
				Duration (years)		Multivariate analysis further adjusted for
				Never	1.0	use of pan–tobacco, alcohol and snuff
				≤ 20	2.6 (0.7–9.9)	
				> 20	2.1 (1.2–27.9)	*p* for trend < 0.025
Sankaranarayanan *et al*. (1989b) India 1983–84	Tongue (141.1–141.4) and floor of mouth (144)	79	232	*Duration (years)* Never-smoker	1.0	Adjusted for age
		17	12	≤ 20	3.9 (1.8–8.7)	
		60	67	≥ 21	2.7 (1.7–4.4)	*p* for trend < 0.001
				Lifetime exposure		
		79	232	Never-smoker	1.0	
		44	47	< 480	2.7 (1.6–4.5)	
		33	32	≥ 480	3.4 (1.8–6.2)	
					p for trend < 0.001	
				No. of bidis/day		Multivariate analysis adjusted for pan–
				Never-smoker	1.0	tobacco chewing and bidi and cigarette
				< 10	5.2 (2.5–10.9)	smoking
				11–20	4.1 (1.8–9.5)	
				> 20	7.5 (2.6–21.7)	*p* for trend < 0.001

Table 2.2.22 (contd)

Reference Country and years of study	Cancer site (ICD-9)	No. of cases	No. of controls	Smoking category	Relative risk (95% CI)	Comments
Sankaranarayanan *et al*. (1990a) India 1983–84	Buccal mucosa (145.0, 145.1, 145.6) and labial mucosa (140.3, 140.4)			*No. of bidis/day*		Hospital-based study; adjusted for age
		125	402	Never-smoker	1.0	
		51	64	≤ 10	2.4 (1.6–3.7)	
		43	55	11–20	2.5 (1.6–3.9)	
		17	20	≥ 21	2.8 (1.4–5.6)	*p* for trend < 0.001
				Lifetime exposure		
		125	402	Never-smoker	1.0	
		51	61	< 400	2.7 (1.7–4.1)	
		12	27	400–499	1.4 (0.7–2.9)	
		48	52	≥ 500	2.9 (1.8–4.5)	*p* for trend < 0.001
				Duration (years)		Multivariate analysis adjusted for pan–tobacco chewing, alcohol and snuff
				Never-smoker	1.0	
				≤ 20	2.9 (1.3–6.6)	
				≥ 21	1.7 (1.1–2.6)	*p* for trend < 0.01
Rao *et al*. (1994) India 1980–84	Oral cavity: lip, anterior tongue, upper and lower alveolus, buccal mucosa and hard palate, excluding base of the tongue (141.0) and soft palate (145.3)			*No. of bidis/day*		Hospital-based study
		407	440	Nonsmoker	1.0	
		163	95	1–10	1.9 (1.4–2.5)	
		64	41	11–20	1.7 (1.1–2.6)	
		66	52	21–30	1.4 (0.9–2.1)	
		10	6	≥ 31	1.8 (0.6–5.6)	*p* for trend < 0.001
				Duration (years)		
		407	440	Nonsmoker	1.0	
		61	64	1–10	1.0 (0.7–1.5)	
		61	48	11–20	1.4 (0.9–2.1)	
		86	39	21–30	2.4 (1.6–3.6)	
		96	43	≥ 31	2.4 (1.6–3.6)	*p* for trend < 0.001

Table 2.2.22 (contd)

Reference Country and years of study	Cancer site (ICD-9)	No. of cases	No. of controls	Smoking category	Relative risk (95% CI)	Comments
Rao *et al*. (1994) (contd)				*Cessation*		Stratified by 4 age groups and 3 areas of residence
		231	159	Current smoker	1.4 (1.0–1.8)	
		42	14	Quit 1 year before	2.1 (1.1–4.3)	
		10	3	Quit 2 years before	2.2 (0.5–12.0)	
		11	10	Quit > 2 years before	0.7 (0.2–1.9)	
		414	447	Nonsmoker	1.0	
		15	3	Hookah/chillum	5.0 (1.4–22.0)	
Rao & Desai (1998) India 1980–84	Base of the tongue (141.0) and anterior tongue (141.1–141.4)			**Base of tongue**		Hospital-based study
		91	337	Nonsmoker	1.0	
		360	186	Bidi smoker	5.9 (4.2–8.2)	
				No. of bidis/day[†]		[†]Includes smokers of both bidis and cigarettes.
		129	438	Nonsmoker[‡]	1.0	[‡]Includes smokers of cigarettes and other forms of tobacco
		141	79	1–10	4.3 (3.0–6.7)	
		94	54	11–20	5.2 (3.4–8.5)	
		107	56	21–30	4.8 (3.2–7.7)	
		24	4	≥ 31	14.3 (4.1–50.7)	
				Duration (years)[†]		
		129	438	Nonsmoker[‡]	1.0	
		30	63	1–10	2.2 (1.3–4.1)	
		64	48	11–20	4.5 (3.1–8.7)	
		123	39	21–30	7.7 (4.8–13.0)	
		149	43	≥ 31	5.1 (3.3–8.3)	
				Anterior tongue		
		73	337	Nonsmoker	1.0	
		53	186	Bidi smoker	1.1 (0.7–1.7)	
				No. of bidis/day[†]		
		86	438	Nonsmoker[‡]	1.0	
		25	79	1–10	1.2 (0.7–2.2)	
		11	54	11–20	0.8 (0.8–1.8)	
		18	56	21–30	1.4 (0.7–2.7)	
		1	4	≥ 31	–	

Table 2.2.22 (contd)

Reference Country and years of study	Cancer site (ICD-9)	No. of cases	No. of controls	Smoking category	Relative risk (95% CI)	Comments
Rao & Desai (1998) (contd)				*Duration (years)* †		†Includes smokers of both bidis and cigarettes. ‡Includes smokers of cigarettes and other forms of tobacco
		86	438	Nonsmoker‡	1.0	
		7	63	1–10	0.5 (0.2–1.3)	
		16	48	11–20	1.4 (0.7–2.7)	
		12	39	21–30	1.2 (0.6–2.8)	
		20	43	≥ 31	1.6 (0.8–3.4)	
				Bidi smoking		Adjusted for alcohol use, illiteracy, non-vegetarian diet and tobacco chewing
				Base of tongue	4.7 (3.5–6.3)	
				Anterior tongue	1.0 (0.6–1.5)	
				Tongue (base + anterior)	3.3 (2.6–4.3)	
Dikshit & Kanhere (2000) India 1986–92	Oral cavity (140, 141.1–141.5, 143, 144, 145.0–145.2, 145.5–145.9)			*Smoking status*		Population-based; adjusted for age and tobacco-quid chewing †70–80% smoked only bidis.
		76	146	Nonsmoker	1.0	
		72	114	Bidi/cigarette smoker†	1.5 (0.9–2.4)	
Balaram *et al*. (2002) India 1996–99	Oral cavity			*No. of bidis/day*		Hospital-based; frequency-matched for age and sex; adjusted for age, centre, education, alcohol use and chewing habits
				Nonsmoker	1.0	
		55	33	< 20	2.0 (1.1–3.8)	
		73	41	≥ 20	2.5 (1.4–4.4)	
Pharynx						
Wasnik *et al*. (1998) India [years of study not reported]	Oropharynx	72	112	Nonsmoker	1.0	Hospital-based; age- and sex-matched control patients — one cancer and one non-cancer
		5	16	Cigarette smoker	0.7 (0.3–1.9)	
		40	31	Bidi/chillum smoker	2.7 (1.6–4.5)	
		6	20	Bidi/cigarette smoker	3.1 (0.6–15.3)	

Table 2.2.22 (contd)

Reference Country and years of study	Cancer site (ICD-9)	No. of cases	No. of controls	Smoking category	Relative risk (95% CI)	Comments
Rao *et al*. (1999)	Oropharynx			*No. of bidis/day*		Hospital-based
India	(141.0, 145.3,	193	445	Nonsmoker	1.0	
1980–84	146.9)	188	77	1–10	4.3 (3.1–6.5)	
		124	52	11–20	4.9 (3.3–7.9)	
		141	53	21–30	4.7 (3.2–7.2)	
		31	4	≥ 31	12.2 (3.8–42.4)	
				Duration (years)		
		193	445	Nonsmoker	1.0	
		44	62	1–10	2.4 (1.5–4.1)	
		89	46	11–20	4.7 (3.4–8.6)	
		159	38	21–30	7.0 (4.5–11.4)	
		192	40	≥ 31	5.2 (3.4–8.1)	
				Bidi smoking		Adjusted for alcohol use, illiteracy, vegetarian/non-vegetarian diet and tobacco chewing
				Nonsmoker	1.0	
				Smoker	4.7 (3.6–6.3)	
Rao *et al*. (1999)	Hypopharynx			*No. of bidis/day*		Hospital-based; alcohol as an additional risk factor
India	(148)	242	445	Nonsmoker	1.0	
1980–84		126	77	1–10	2.1 (1.5–3.1)	
		81	52	11–20	2.5 (1.6–4.0)	
		112	53	21–30	3.5 (2.4–5.5)	
		25	4	≥ 31	8.3 (2.3–26.0)	
				Duration (years)		
		242	445	Nonsmoker	1.0	
		44	62	1–10	1.8 (1.1–3.1)	
		61	46	11–20	2.7 (1.8–4.9)	
		95	38	21–30	3.3 (2.2–5.7)	
		144	40	≥ 31	3.0 (1.9–4.7)	
				Bidi smoking		Adjusted for alcohol use, illiteracy, vegetarian/non-vegetarian diet and tobacco chewing
				Nonsmoker	1.0	
				Smoker	2.8 (2.1–3.7)	

Table 2.2.22 (contd)

Reference Country and years of study	Cancer site (ICD-9)	No. of cases	No. of controls	Smoking category	Relative risk (95% CI)	Comments
Dikshit & Kanhere (2000) India 1986–92	Oropharynx (posterior tongue, soft palate, uvula, nasopharynx, hypopharynx) (141.0, 141.6, 145.3, 145.4, 146, 147, 148.0–149.0)			*Bidi smoking*		Population-based; adjusted for age and tobacco quid chewing
		59	NR	No	1.0	
		188		Yes	7.3 (4.7–11.2)	
		59	NR	No. of bidis/day		
		63		1–10	4.1 (2.4–7.0)	
		84		11–20	11.4 (6.5–19.9)	
		41		> 20	17.0 (7.7–37.6)	χ^2_{trend} = 3.82 (NS)
				Nonsmoker	1.0	
				Bidi smoker only	7.9 (5.1–12.4)	
				Cigarette smoker only	4.1 (2.0–8.4)	
				Bidi and cigarette smoker	6.2 (2.8–13.4)	

NR, not reported

Table 2.2.23. Cross-sectional studies on bidi and other tobacco smoking and oral lesions

Reference Country	Oral lesion	Smoking category	No. of lesions	Prevalence (%)	Total	Comments
Van der Eb *et al.* (1993) India	Palatal lesions	Nonsmoker	5	3	161	Randomly selected population sample; 9 carcinomas of the hard palate, all among reverse chutta smokers
		Chewing tobacco	0	0	10	
		Cigarette	3	21.4	14	
		Bidi	11	55.0	20	
		Conventional chutta	34	56.7	60	
		Ex-conventional chutta/bidi	6	42.9	14	
		Reverse chutta	139	86.9	160	
		Ex-reverse chutta	16	76.2	21	
		Mixed habits	11	55.0	20	
		Total	225	46.9	480	

Reference Country	Oral lesion	No. of cases	No. of controls	Smoking category	RR (95% CI)	Comments
Macigo *et al.* (1996) Kenya	Oral leukoplakia			**Kiraiku**[†]		Population-based [†]Home-processed hand-rolled products
		42	120	Never-smoker	1.0	
		29	17	Former smoker	4.9 (2.3–10.4)	
		14	4	Current smoker	10.0 (2.9–43.4)	
				Duration (years)		
		24	15	≤ 10	4.6 (2.1–10.2)	
		5	2	> 10	7.1 (1.1–76.6)	
				Years since quitting		
		11	8	≥ 10	3.9 (1.4–11.6)	
		12	7	5–9	4.9 (1.7–14.9)	
		6	2	≤ 4	8.6 (1.4–88.7)	

Table 2.2.24. Intervention studies on tobacco use and oral lesions in India

Place Reference	Tobacco habit	Oral lesion	Sex	Intervention cohort		Control cohort		Rate ratio	Comments
				No.	Incidence rate/1000	No.	Incidence rate/1000		
Bhavnagar District									
Gupta *et al*. (1986b)	Bidi	Leukoplakia	Men	224	41.9	58	47.6	0.88	After 5 years of follow-up
Srikakulam District									
Gupta *et al*. (1986b)	Reverse smoking	Palatal lesions	Men	52	163.3	671	427.7	0.38	After 5 years of follow-up
			Women	428	292.0	1 167	513.9	0.57	
				Person–years	Incidence rate/1000	Person–years	Incidence rate/1000		
Gupta *et al*. (1994)	Reverse smoking	Palatal lesions	Men	7 341	1.1	7 718	6.2		After 10 years of follow-up
			Women	49 522	3.4	11 210	11.4		
				Observed	Expected				
Ernakulam District									
Gupta *et al*. (1990)	Bidi	Leukoplakia	Men	63	142.6			0.4	After 8 years of follow-up
			Women	0	2.6			0.0	
	Cigarette		Men	0	12.8			0.0	
			Women	0	0.0			–	

Table 2.2.24 (contd)

Place Reference	Tobacco habit	Oral lesion	Sex	Intervention cohort			Control cohort		Rate ratio	Comments
				Person–years	Incidence rate/1000		Person–years	Incidence rate/1000		
Gupta *et al*. (1992)	Bidi	Leukoplakia								
			Men	48 265	1.46		15 529	3.02	0.4	
			Women	1 444	–		199	5.86	0.0	
	Cigarette		Men	2 699	–		2 165	1.46	0.0	
			Women	6	–		0	0	–	
				Stopped			All others			
				Person–years	Observed	Expected	Person–years	Observed		
	Bidi	Oral lesions	Men	ca. 3000	8	42.3	ca. 40 000	601		
					Observed	Incidence/ 100 000	Observed	Incidence/ 100 000		
		Leukoplakia			1	24	80	155	0.15	

Table 2.2.25. Case–control studies of bidi and other tobacco smoking and lung cancer

Reference Country and years of study	No. of cases	No. of controls	Smoking category	Relative risk (95% CI)	Comments
Dikshit & Kanhere (2000) India 1986–92	17	146	Nonsmoker	1.0	Population-based; adjusted for age
	100	81	Bidi smoker only	11.6 (6.4–21.3)	
	15	20	Cigarette smoker only	7.7 (3.2–18.4)	
	31	13	Bidi and cigarette smoker	24.1 (10.4–56.1)	
Gupta *et al*. (2001) India 1995–97	26	172	Nonsmoker	1.0	Hospital-based; males; relative risks adjusted for age and education
	208	261	Ever-smoker (any)	5.0 (3.1–8.0)	
	137	162	Bidi smoker	5.8 (3.4–9.7)	
	78	103	Cigarette smoker	3.9 (2.1–7.1)	
	12	31	Hookah smoker	1.9 (0.9–4.4)	
			Bidis		†Average consumption of cigarette equivalents (see text)
			Average no./day†		
	11	39	1–4	1.8 (0.8–4.0)	
	46	54	5–9	5.9 (3.2–10.8)	
	67	63	10–19	6.8 (3.9–12.1)	
	13	6	≥ 20	12.3 (4.2–36.1)	
			Duration (years)		
	23	45	0–24	3.7 (1.8–7.7)	
	48	36	25–34	9.6 (4.9–18.7)	
	30	48	35–44	3.7 (1.9–7.2)	
	37	33	≥ 45	6.4 (3.3–12.6)	
			Pack–years		
	41	71	0–9	3.9 (2.1–7.1)	
	57	54	10–19	6.5 (3.6–11.7)	
	26	23	20–29	6.9 (3.4–14.3)	
	13	14	≥ 30	5.3 (2.2–12.9)	
			Hookah		
			Average no./day†		
	12	31	1–4	1.9 (0.9–4.4)	
			Duration (years)		
	1	9	0–24	0.5 (0.1–4.4)	
	0	6	25–34	–	
	6	10	35–44	2.7 (0.9–8.5)	
	5	6	≥ 45	4.4 (1.2–16.4)	
			Pack–years		
	12	31	0–9	1.9 (0.9–4.4)	

Table 2.2.26. Case–control studies on bidi and other tobacco smoking and cancer of the larynx and oesophagus

Reference Country and years of study	No. of cases	No. of controls	Smoking category	Relative risk (95% CI)	Comments
Larynx					
Sankaranarayanan			*No. of bidis/day*		Hospital-based
et al. (1990b)	101	402	None	1.0	
India	31	65	≤ 10	1.8 (1.1–2.9)	
1983–84	31	55	11–20	2.1 (1.3–3.5)	
	25	20	≥ 21	5.1 (2.7–9.6)	*p* for trend < 0.001
			Duration (years)		Adjusted for duration of cigarette smoking,
			Never	1.0	frequency of bidi and cigarette smoking and
			≤ 20	1.3 (0.3–6.4)	duration of alcohol use
			≥ 21	7.1 (4.0—12.5)	*p* for trend < 0.001
Rao *et al*. (1999)			*No. of bidis/day*		Hospital-based
India	203	445	Nonsmoker	1.0	
1980–84	93	77	1–10	1.8 (1.2–2.8)	
	38	52	11–20	1.4 (0.8–2.4)	
	76	53	21–30	2.5 (1.7–4.1)	
	11	4	≥ 31	3.8 (0.9–14.1)	
			Duration (years)		
	203	445	Nonsmoker	1.0	
	24	62	1–10	1.2 (0.7–2.3)	
	44	46	11–20	2.3 (1.4–4.3)	
	62	38	21–30	2.3 (1.4–4.1)	
	88	40	≥ 31	2.0 (1.3–3.2)	
			Bidi smoking		Adjusted for alcohol use, illiteracy,
			Nonsmoker	1.0	vegetarian/non-vegetarian diet and tobacco
			Smoker	2.1 (1.6–2.8)	chewing

Table 2.2.26 (contd)

Reference Country and years of study	No. of cases	No. of controls	Smoking category	Relative risk (95% CI)	Comments
Oesophagus					
Sankaranarayanan			*No. of bidis/day*		Hospital-based
et al. (1991)	88	402	None	1.0	
India	45	65	≤ 10	2.8 (1.8–4.5)	
1983–84	45	55	11–20	3.5 (2.2–5.5)	
	24	20	≥ 21	5.2 (2.7–10.0)	*p* for trend < 0.001
			Duration (years)		Adjusted for the number of bidis and cigarettes
			Never	1.0	smoked daily, alcohol use and pan–tobacco
			≤ 20	2.1 (0.8–5.9)	chewing
			> 20	4.7 (2.8–7.9)	*p* for trend < 0.001
Nandakumar *et al*.			*All cases*		Hospital-based; age- and sex-matched, adjusted
(1996)	36	139	Nonsmoker	1.0	for tobacco chewing, pan chewing without
India	115	144	Bidi smoker	4.0 (2.3–6.8)	tobacco, alcohol drinking and cigarette smoking
1982–85			*Upper third*		
	4	16	Nonsmoker	1.0	
	11	8	Bidi smoker	7.1 (1.1–46.8)	
			Middle third		
	14	76	Nonsmoker	1.0	
	60	73	Bidi smoker	6.0 (2.5–14.5)	
			Lower third		
	12	37	Nonsmoker	1.0	
	34	48	Bidi smoker	3.9 (1.4–10.7)	
Nayar *et al*. (2000),			*Bidi smoking*		Hospital-based; matched controls; adjusted for
India	83	112	Never-smoker	1.0	betel quid with tobacco and diet (other
1994–97	66	37	Daily smoker	2.0 (1.2–3.3)	vegetables besides leafy greens)

Table 2.2.27. Case–control study of bidi and other tobacco smoking and stomach cancer

Reference Country and years of study	No. of cases	No. of controls	Smoking categories	Relative risk (95% CI)	Comments
Gajalakshmi & Shanta (1996) India 1988–90	72	40	*Current smoker* Bidi	3.2 (1.8–5.7)	Hospital-based; matched on age, sex, religion and mother tongue
	43	33	Cigarette	2.0 (1.1–3.6)	
	31	22	Chutta	2.4 (1.2–4.9)	
	13	2	Combination	8.2 (1.7–38.9)	
			Bidis		
			Age at starting smoking (years)		
	10	5	> 30	3.6 (1.0–13.5)	
	27	16	21–30	2.7 (1.2–5.9)	
	35	19	≤ 20	3.7 (1.7–8.3)	p for trend < 0.001
			Lifetime exposure		
	21	17	Mild	2.0 (0.9–4.3)	
	17	11	Moderate	5.3 (1.6–18.3)	
	34	12	Heavy	4.5 (1.8–11.3)	p for trend < 0.001
			Chuttas		
			Age at starting smoking (years)		
	3	5	> 30		
	12	6	21–30	2.2 (0.3–13.5)	
	16	11	≤ 20	2.4 (0.8–7.2)	
				2.3 (0.9–6.0)	
			Lifetime exposure		
	12	12	Mild	2.8 (0.9–8.4)	
	8	7	Moderate	1.5 (0.5–4.6)	
	8	3	Heavy	4.4 (1.2–16.1)	p for trend < 0.05

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