2.10 Cancer of the lung

A possible link between alcoholic beverage consumption and the risk for lung cancer has long been speculated; however, epidemiological evidence has been considered to be inconclusive. The data available to the previous IARC Working Group (IARC, 1988) did not allow the conclusion that the association between consumption of alcoholic beverages and lung cancer was causal.

Lung cancer is the most common and fatal cancer in the world. The major cause of lung cancer is tobacco smoking, to which 80–90% of cases are attributable. A high

Table 2.49 Case–control studies of pancreatic cancer and alcoholic beverage consumption

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Williams & Horm (1977), USA, Third National Cancer Survey, 1969–71	7518 (all sites, men and women), aged ≥35 years; histological confirmation not stated; 57% randomly selected	Randomly selected patients with cancer of other non-related sites	Interviewer-administered questionnaire	*Glasses/ year* None 51 ≥52 None 51 ≥52	 *Men* 1.0 0.72 1.34 *Women* 1.0 0.58 0.59	Age, race, smoking	
MacMahon *et al.* (1981), Boston, Rhode Island, USA, 1974–79	369 (218 men, 151 women), aged ≤79 years; 100% histologically confirmed; response rate, ~68%	644 hospital-based, matched by physician, excluding pancreas/ liver disease and tobacco-/alcohol-related diseases; 42% other cancers; response rate, ~61%	Interviewer-administered questionnaire	*Alcohol drinking* Non-drinker Ever Regular	 1.0 0.9 (0.6-1.3) 0.8 (0.5-1.3)	Physician, time of hospitalization, age	No proxies used; no association in men or women separately, or by type of beverage
Manousos *et al.* (1981), Greece, 1976–77	50 (32 men, 18 women), all ages; 100% histologically confirmed; response rate not stated	206 hospital-based (non-malignant, excluding liver/ pancreas disease); response rate not stated	Not stated; standard record form obtained from patient	*Alcohol drinking (g/ day)* ≤10 >10	 1.0 0.7 (0.3–1.3)	Age, sex	

Table 2.49 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Durbec *et al.* (1983), France, 1979–80	69 (37 men, 32 women), aged 30–90 years; 100% histologically confirmed; response rate not stated	199 population-based (door-to-door); matched by age, sex, type of residence (no digestive diseases); response rate not stated	Interviewer-administered questionnaire	*Alcohol intake (g/day)* Per 10 g/day Duration (per year)	 1.24 (1.05–1.44) 0.72 (0.53–0.98)	Matching factors plus carbohydrate, fats; adjustment for smoking made no difference	
Wynder *et al.* (1983), USA, American Health Foundation, 1977–81	275 (153 men, 122 women), aged 20–80 years; 100% histologically confirmed; response rate, 45%	7994 hospital-based (non-tobacco-related diseases); matched by age, sex, race, ward; response rate, 35%	Interviewer-administered questionnaire	*Alcohol use (oz/day)* 0 <1 1–3 3–5 ≥5	*Men only* 1.0 1.2 (0.70–1.96) 1.1 (0.64–1.96) 1.0 (0.51–2.01) 1.6 (0.92–2.63)	Age, smoking	No association for women
Gold *et al.* (1985), Baltimore, USA, 1978–80	201 men and women; age range not stated; 62% histologically confirmed; response rate, 70%	201 hospital- and population-based; hospital (non-malignant) matched on age, sex, race, hospital, date of admission; population (random-digit dialling) matched on age, sex, telephone exchange area; response rate not stated	Interviewer-administered questionnaire	*Wine intake 1 year ago (glasses/week)* Never Ever	 1.0 0.52 (0.32–0.84) *p*-value=0.007 (population controls)	Matching factors plus religion, occupation, smoking	Relative risk, 0.86 (NS) for hospital controls; 75% of case interviews with proxies

Table 2.49 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Mack *et al.* (1986) Los Angeles, USA, 1976	490, aged <65 years; ~80% histologically confirmed; response rate, 67%	Population-based (neighbourhood algorithm); matched by age, sex, race, area; response rate not stated	Interviewer-administered questionnaire	*Alcohol (g/day)* Reference <40 40–79 ≥80	 1.0 0.7 (0.5–1.1) 0.8 (0.5–1.3) 1.2 (0.7–2.2)	Matching factors	~75% cases had proxy information; no association by smoking status
Norell *et al.* (1986), Sweden, 1982–84	99 (55 men, 44 women), aged 40–79 years; final diagnosis based on resection or autopsy (61%), radiology and biopsy (33%), or clinical and radiological evidence alone (6%); response rate, ~80%	138 population-based (birth records); matched by age, sex; 163 hospital (hernia); matched by age, sex; response rate, 85 and 90%	Self-administered questionnaire, followed by telephone interview if necessary	*Past intake (g/day)* 0–1 2–9 ≥10 0–1 2–9 ≥10	*Population controls* 1.0 0.7 (0.5–1.2) 0.6 (0.3–1.1) *Hospital controls* 1.0 0.5 (0.3–0.9) 0.5 (0.3–1.0)	Matching factors	16% of cases had proxy information
Voirol *et al.* (1987), Switzerland, 1976–80	88 (43 men, 45 women) confirmed by clinicians; age range not stated; 67% histologically confirmed	336 population-based; matched by age; response rate, 64%	Interviewer-administered questionnaire	*Beer (per dL intake)* None 1.3 *Wine (per dL intake)* None 1.8	 1.0 2.85 (significant) 1.0 0.86 (NS)		

Table 2.49 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Falk *et al.* (1988), Louisiana, USA, 1979–83	363; 82% histologically confirmed; response rate, 86%	1234 hospital-based (non-malignant); matched on age, sex, race; response rate, 87%	Interviewer-administered questionnaire	*Highest intake (drinks/ week)* None <6 6–11 12–26 ≥27	*Men only* 1.0 2.04 1.38 1.07 1.50	Age, respondent type, smoking, residence, income, diabetes, fruit intake	53% cases and 13% controls with proxy information; no association in women; no association by type of beverage
Cuzick & Babiker (1989), United Kingdom, 1983–86	216, all ages; 30% histologically confirmed; response rate not stated	212 hospital-based (non-malignant); 67 general practitioners; response rate not stated	Interviewer-administered questionnaire	*Intake 1 year ago (units/week)* None <4 4–14 ≥15 Former	 1.0 0.95 0.97 1.73 *p* for trend <0.1 2.71 (significant)	Age, sex, social class, urbanization, smoking	Increased risk for intake 10 years ago (≥15 units/ week: relative risk, 2.3); strongest association with beer
Ferraroni *et al.* (1989), Italy, 1983–88	214, aged <75 years; 100% histologically confirmed; response rate, >98%	1944 hospital-based (non-malignant, non-digestive tract disorders, not related to tobacco, alcohol or coffee intake, and not requiring long-term modification to diet); response rate, >98%	Interviewer-administered questionnaire	*Alcohol intake (drinks/day)* <3 3–6 >6 *p* for trend	 1.0 1.14 1.46 NS	Age, sex, social class, education, marital status, smoking, coffee intake	Most (>90%) drank wine only

Table 2.49 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Olsen *et al.* (1989), Minneapolis, USA, 1980–83	212 men (death as stated on death certificate), aged 40–84 years; 66% histologically confirmed; response rate, 85%	220 population-based (random-digit dialling); matched by age, race; response rate, >70%	Interviewer-administered questionnaire	*Intake 2 years before death (drinks/day)* 0 1 2–3 ≥4	 1.0 0.77 (0.47–1.30) 1.42 (0.67–3.03) 2.69 (1.00–7.27)	Age, education, diabetes, smoking, meat, vegetable intake	100% proxy information from cases and controls; increased risk for high intake of beer (≥4 drinks/ day)

Table 2.49 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Bouchardy *et al.* (1990), pooled analysis of studies in France, Italy, Switzerland, 1976-85	494 Italy: 245, aged <75 years; 100% histologically confirmed; recruited 1983–88; response rate, >97% France: 171; age range not stated (mean age, 63 years); 64% histologically confirmed; recruited 1982–85; response rate, >80% Switzerland: 91; age range not stated;67% histologically confirmed; recruited 1976–81; response rate, 16%	1704 Italy: 1082 hospital-based (non-malignant, non-digestive tract disorders, unrelated to tobacco or alcohol); response rate, >97% France: 268 hospital-based (first group cancer unrelated to tobacco, second group non-malignant unrelated to tobacco); matched by age, sex, interviewer; response rate not stated Switzerland: 383 population-based (through population register); matched by age, sex; response rate, 64%	Interviewer-administered questionnaire	*Alcohol intake (glasses/day)* None <2 <3 <4 4–5 6–7 ≥8 *p* for trend	 1.0 0.9 (0.6–1.2) 0.9 (0.6–1.2) 1.1 (0.7–1.7) 0.7 (0.5–1.1) 1.0 (0.6–1.6) 0.8 (0.5–1.3) NS	Age, sex, social class, smoking	No association for wine, beer or spritis; significant negative association with increasing alcohol intake in the French study, due to wine consumption; significant positive association with beer intake in the Swiss study; no difference by smoking status

Table 2.49 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Baghurst *et al.* (1991), Australia, 1984–87	104 (52 men, 52 women), all ages; verified through medical records; response rate, 62%	253 population-based (electoral roll); matched by age, sex; response rate, ~50%	Self-administered questionnaire checked by interviewer	*Intake 1 year before interview (g/day)* None 0–4.4 4.5–17.8 ≥17.9	 1.0 0.64 (0.34–1.23) 0.41 (0.20–0.82) 0.41 (0.19–0.87) *p* for trend=0.004	Age, sex, smoking	Proxy interview required for ~10% cases
Farrow & Davis (1990), Washington, USA, 1982–86	148 men, aged 20–74 years; 46% histologically confirmed; response rate, 68%	188 population-based (random-digit dialling); matched by age; response rate, 68%	Telephone-interview questionnaire	*Usual intake 3 years before diagnosis (drinks/week)* <4 4–14 ≥15	 1.0 0.7 (0.4–1.2) 0.8 (0.5–1.4)	Age, smoking, race, education	No association for type of beverage
Ghadirian *et al.* (1991), Canada, 1984–88	179 (97 men, 82 women), aged 35–79 years; all clinical or histological diagnoses; response rate, 60%	239 population-based (random digit-dialling and telephone directory listings); matched by age, sex, area; response rate not stated	Interviewer-administered questionnaire	*Total intake (g)* Never 2840 11 171 34 554 709 560	 1.0 0.59 (0.26–1.34) 1.0 (0.44–2.29) 0.71 (0.31–1.61) 0.65 (0.30–1.44)	Age, sex, education, response status	75% of case interviews with proxies (17% controls); no association for type of beverage

Table 2.49 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Jain *et al.* (1991), Canada, 1983–86	249 men and women admitted to hospital, aged 35–79 years; 69% histologically confirmed; response rate, 46%	505 population-based (residence lists); matched by age, sex, borough, proxy; response rate, 39%	Interviewer-administered questionnaire	*Lifetime intake* (g) None 0–32 600 32 600–162 150 ≥162 150 per 250 000 g	 1.0 0.91 (0.55–1.52) 0.78 (0.47–1.31) 0.86 (0.50–1.47) 0.94 (0.79–1.12)	Matching factors plus smoking, energy intake, fibre intake	78% cases had proxy interview, matched with proxy control; no association with type of beverage
Bueno de Mesquita *et al.* (1992), Netherlands, 1984–88	176 men and women, aged 35–79 years; 68% histologically confirmed; response rate, >90%	487 population-based (local registries); matched by age, sex; response rate, >65%	Interviewer-administered questionnaire	*Lifetime intake (g)* Never <22 471 22 472–128 971 ≥128 972	 1.0 0.97 (0.53–1.77) 0.93 (0.49–1.76) 1.25 (0.65–2.43) *p* for trend=0.55	Age, sex, response status, lifetime smoking, energy intake, vegetables	Significant negative association for white wine; 42% of case interviews with proxy (29% controls)
Lyon *et al.* (1992), Utah, USA, 1984–87	149 reviewed by medical records, aged 40–79 years; response rate, 88%	363 population-based (random-digit dialling, HCFA); matched by age, sex, county; response rate, 77%	Interviewer-administered questionnaire (by telephone)	*Alcohol use* Never Ever	 1.0 1.6 (1.08–2.38)	None	100% information from proxies

Table 2.49 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Mizuno *et al.* (1992), Japan, 1989–90	124 (68 men, 56 women); histological confirmation not stated; response rate not stated	124 hospital-based (non-malignant); matched by age, sex, hospital; response rate not stated	Questionnaire (not stated if self- or interviewer-administered)	*Frequency of intake (times/week)* None 1–2 1–2 3–5 Every day	 1.0 1.20 (0.51–2.85) 1.07 (0.35–3.26) 0.74 (0.28–1.95) 1.24 (0.56–2.71)	Matching factors	No association with age when drinking started duration, or quantity of sake or beer; controls included patients with digestive diseases
Kalapothaki *et al.* (1993), Greece, 1991–92	181 undergoing surgery (115 men, 66 women); 100% histologically confirmed; response rate, 90%	181 hospital-based (excluding disease related to diet, non-malignant, no gastrointestinal disease) and 181 visitors (residents of area and visitors to hospital); matched by age, sex, hospital; response rate, 93%	Interviewer-administered questionnaire	*Glasses/day* 0 <1 1–2 3–4 ≥4 per 1 glass/day	*Visitor controls* 1.0 0.94 (0.52–1.72) 1.09 (0.52–2.26) 0.62 (0.20–1.91) 0.81 (0.39–1.68) 0.96 (0.83–1.11)	Matching factors (for continuous variable, past residence, education, diabetes)	No association with hospital controls

Table 2.49 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Zatonski *et al.* (1993), Poland, 1985–88	110 (68 men, 42 women), confirmed by clinical and pathological records; 44% histologically confirmed; response rate, 77%	195 population-based (method not stated); matched on age, sex, residence; response rate, 87%	Interviewer-administered questionnaire	*Lifetime intake* Never Ever	 1.0 1.29 (0.67–2.48)	Age, sex, education, tea, coffee, smoking	71% of cases (0% of controls) used proxy; increased risk for spirits (Q4, 2.5; p=0.07), the most common drink consumed
Gullo *et al.* (1995), Italy, 1987–89	570 (319 men, 251 women), aged 22–79 years; 70% histologically confirmed	570 hospital-based (non-malignant); matched by age, sex, social class, region	Interviewer-administered questionnaire	*Alcohol (g/day)* 0 <50 50–100	 1.0 0.76 (0.56–1.04) 1.06 (0.63–1.77)	Age, sex	No association for men or women; most drank wine
Ji *et al.* (1995), China, 1990–93	451 (264 men, 127 women) identified through registry, aged 30–74 years; 57% histologically/surgically confirmed; response rate, 78%	1552 population-based (resident registry); matched by age, sex; response rate not specified	Interviewer-administered questionnaire	*Alcohol intake (g/week)* None <161 161–332.4 332.5–564 ≥565	*Men* 1.0 0.7 (0.4–1.3) 1.1 (0.7–1.8) 0.9 (0.5–1.4) 0.9 (0.5–1.4)	Age, income (women only: green tea, education)	Next of kin attended interviews for 38% of cases, 10% of controls; no association with duration, lifetime alcohol intake or type of beverage

Table 2.49 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Silverman *et al.* (1995); Silverman (2001), USA, 1986–-89	486 surviving men and women (307 white, 179 black), aged 30–79 years; confirmed through medical records; response rate, 46% (white) and 44% (black)	2109 (1164 white, 945 black) population-based: 1. aged 30–64 years (random-digit dialing); matched by age, sex, ethnicity; response rate, 78% for both white and black; 2. aged 65–79 years (HCFA), stratified random sample; response rate, 73% (white) and 78% (black)	Interviewer-administered questionnaire	*Alcohol consumption (drinks/ week)* Never 1–<8 8–<21 21–<57 ≥57 Never 1–<8 8–<21 21–<57 ≥57 *p* for trend Never 1–7 8–20 21–56 Never 1–7 8–20 21–56 *p* for trend	 *White men* 1.0 0.8 (0.5–1.44) 0.8 (0.4–1.3) 1.0 (0.6–1.9) 1.4 (0.6–3.2) *Black men* 1.0 0.6 (0.2–1.6) 1.2 (0.5–2.6) 0.6 (0.2–1.6) 2.2 (0.9–5.6) 0.04 *White women* 1.0 0.7 (0.4–1.1) 0.4 (0.2–0.9) 0.9 (0.3–3.0) *Black women* 1.0 1.1 (0.5–2.2) 1.8 (0.9–4.0) 2.5 (1.02–5.9) 0.03	Age, area, cigarette smoking, gallbladder disease, diabetes	Never/ever drinking not significant except for white women (0.6; 95% CI, 0.4–0.97); no significant differences by beverage type; similar association found in nonsmokers

Table 2.49 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Partanen *et al.* (1997), Finland, 1984–87	662 deceased men and women, aged 40–74 years; identified through cancer registry; response rate, 47%	1770 hospital-based (malignancies of the stomach, colon or rectum)	Self-administered questionnaire	*Distilled beverage intake in 1960s* None/ occasional Moderate Heavy *Wine/beer* None/ occasional Moderate Heavy	 1.00 1.17 (0.92–1.48) 1.22 (0.82–1.80) 1.00 1.16 (0.91–1.48) 1.61 (1.07–2.42)	Age, sex, tobacco smoking	
Tavani *et al.* (1997), Italy, 1983–92	361 men and women, aged 17–79 years; 100% histologically confirmed; response rate, ~97%	997 hospital-based (non-malignant, non-smoking-/alcohol-related); response rate, ~97%	Interviewer-administered questionnaire	*Usual intake (drinks/day)* None <4 >4–7 >7–8 >8 *p* for trend	 1.0 0.9 (0.7–1.3) 1.1 (0.7–1.7) 1.4 (0.7–2.7) 1.1 (0.5–2.2) 0.57	Age, sex, education, smoking, diabetes, pancreatitis, cholelithiasis	No proxy information; no association for type of beverage (90% of population drank wine) or duration

Table 2.49 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Soler *et al.* (1998), Italy, 1983–92	362 men and women, aged <75 years; 100% histologically confirmed; response rate, ~97%	1552 hospital-based (non-malignant); response rate, ~97%	Interviewer-administered questionnaire; total alcohol intake (frequency, duration, quantity provided)	*Total alcohol intake* Low Intermediate High	 1.0 0.83 (0.61–1.13) 1.20 (0.89–1.67)	Age, sex, area, education, smoking	No proxy interviews
Talamini *et al.* (1999), Italy, 1990–95	69 men (no pancreatitis); 100% histologically confirmed; response rate not specified	700 population-based (electoral roll) who had medical check-up, recruited 1985–87; response rate not specified	Interviewer-administered questionnaire	*Alcohol (g/day)* 0–40 41–80 > 80	 1.0 0.5 (0.2–1.0) 0.4 (0.2–1.0)	Smoking	

Table 2.49 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Villeneuve *et al.* (2000), multisite, Canada, 1994–97	583 (322 men, 261 women), aged 30–76 years; 100% histologically confirmed; response rate, 55%	4813 population-based (health insurance records, Ministry of Finance records, random-digit dialling); matched by age, sex; response rate, 65–71%	Self-mailed questionnaire with telephone follow-up	*Alcohol (drinks/week)* 0 <3 3–<7 7–<14 ≥14 0 <3 3–<7 ≥7	 *Men* 1.0 0.83 (0.56–1.25) 0.86 (0.57–1.28) 1.20 (0.79–1.80) 1.36 (0.93–2.00) *Women* 1.0 0.90 (0.65–1.25) 0.59 (0.34–1.02) 0.95 (0.57–1.56)	Age, area, parity, coffe, smoking, energy intake, fat intake	Proxies used for 24% of cases
Lu *et al.* (2006), China, 2002–04	119 identified through hospital records and verified by pathology, surgical and clinical records; age range not stated; histological confirmation not stated; response rate not stated	238 population-based (procedure not stated); matched by age, sex, region, marital status; response rate not stated	Interviewer-administered questionnaire	*Alcohol duration (drink–years)* None ≤20 >20 *p* for trend	 1.0 1.003 (CI not stated) 3.68 (1.60–8.44) Significant [not reported]	Age, sex, smoking	Limited methodological details provided

CI, confidence interval; HCFA, Health Care Financial Administration; NS, not significant

correlation has been identified between use of tobacco and consumption of alcohol in many populations. As such, careful adjustment for smoking is one of the most important requirements for a valid interpretation of the effects of alcohol.

Factors important for causal inference, such as strength of the association, dose–response relationship, histological types, types of alcoholic beverage, and potential confounding by and interactions with tobacco smoking are considered here. The risks for lung cancer in relation to total alcoholic beverage consumption are summarized in Tables 2.50–2.52; the effects of alcoholic beverage consumption and the risk for lung cancer by histological types are presented in Tables 2.53 and 2.54; the effects of types of alcoholic beverage are presented in Tables 2.55–2.60; the combined or joint effects or effect modification of alcoholic beverage consumption and tobacco smoking are shown in Tables 2.61 and 2.62; the relationships between alcoholic beverage consumption and the risk for lung cancer among nonsmokers are shown in Tables 2.63 and 2.64.

2.10.1 *Total alcoholic beverage consumption*

(a) Cohort studies of special populations (Table 2.50)

All six studies based on cohorts of alcoholics—populations that have excessive alcoholic beverage intake—reported elevated mortality from lung cancer (Schmidt & Popham, 1981; Adami *et al*., 1992a; Tønnesen *et al*., 1994; Sigvardsson *et al*., 1996; Sørensen *et al*., 1998; Boffetta *et al*., 2001). However, due to the lack of control for tobacco smoking in all studies, the possibility that the observed association might be largely explained by the confounding effect of tobacco smoking can not be ruled out.

(b) Cohort studies of the general population (Table 2.51)

Among 20 cohort studies of the general population that provided tobacco smoking-adjusted risk estimates for total alcoholic beverage use, 10 reported an elevated risk for lung cancer associated with alcoholic beverage consumption, although it was seldom significant. Of the studies that examined high levels of alcoholic beverage intake (≥3 or ≥5 drinks/day), some reported elevated risks that became statistically significant at the highest category of alcoholic beverage consumption, all in men (Prescott *et al*., 1999; Lu *et al*., 2000a; Balder *et al*., 2005). Studies that used low drinking levels (e.g. 1–2 drinks/day) as the highest category did not find a significant association between these relatively low exposures and risk for lung cancer (Kono *et al*., 1986; Stemmermann *et al*., 1990; Breslow *et al*., 2000; Freudenheim *et al*., 2005).

Most cohort studies that reported a positive association also demonstrated a significant dose–response relationship. Other studies observed no association between alcoholic beverages and the risk for lung cancer at the highest level of consumption for both genders (Korte *et al*., 2002 [Cancer Prevention Study, II]; Nishino *et al*., 2006; Rohrmann *et al*., 2006) and in women (Prescott *et al*., 1999).

Table 2.50 Cohort studies of total alcoholic beverage consumption and lung cancer in special populations

Reference, location, name of study	Cohort description	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Schmidt & Popham (1981), Ontario, Canada, Cohort of Alcoholics	9889 men admitted for alcoholic treatment in 1951–70 in Ontario, Canada; mortality follow-up, 1951–71; mortality and cause-specific mortality ascertainment, death records and death certificates; 96% follow-up	Alcoholic	89	**SMR**		347 patients whose vital status could not be determined were assumed to be alive at the study cut-off date.
		Local reference		1.7 (p<0.01)	Age	
		US veteran reference		2.7 (p<0.01)	Total	
				4.4 (p<0.01)	1–9 cigs/day	
				2.2 (p<0.01)	10–20 cigs/day	
				0.98	21–39 cigs/day	
Adami *et al.* (1992a), Central Sweden, Cohort of alcoholics	9353 (8340 men, 1013 women) subjects with a hospital discharge of alcoholism; follow-up, 1965–84; case ascertainment, Nationwide Registry of Cause of Death	Alcoholic		**SIR**	Age, calendar year	Estimates not adjusted for smoking; updated analysis in Boffetta *et al.* (2001); cancers occurring during the first year of follow-up were excluded
		Men	76	2.1 (1.7–2.6)		
		Women	3	2.7 (0.6–8.0)		
		Age <50 years		6.7 (2.2–15.7)		
		Age 50–64 years		3.5 (2.4–4.9)		
		Age ≥65 years		1.5 (1.0–2.0)		
Tønnesen *et al.* (1994), Copenhagen, Denmark, Cohort of Alcoholics	18 307 alcoholics (15 214 men, 3093 women) treated at a public outpatient clinic in Copenhagen in 1954–87; cancer case ascertainment, Danish Cancer Registry, 95%; mortality follow-up through population registry	*Alcoholic*		**SIR**	Age, sex, calendar period	Estimates not adjusted for smoking; reference, national cancer incidence
		Men	456	2.5 (2.3–2.7)		
		Women	29	3.7 (2.5–5.4)		
		Total	485	2.6 (2.3–2.8)		

Table 2.50 (continued)

Reference, location, name of study	Cohort description	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Sigvardsson *et al.* (1996), Sweden, Temperance Boards Study	Nested case-control study; 15 508 alcoholic women identified from the Temperance Board records; comparison group of 15 508 women individually matched on day of birth, region; follow-up, [1947–77]; case ascertainment, Swedish Cancer Registry	Alcoholic	139 (bronchus, lung) 4 (lung, unspecified)	5.0 (3.3–7.4) 4.0 (0.5–36.0)	Age, region	Estimate not adjusted for smoking
Sørensen *et al.* (1998), Denmark, Cohort of 1-year Survivors of Cirrhosis	11 605 1-year survivors of cirrhosis identified from Danish National Registry of Patients that covered all hospital admissions in Denmark; follow-up, 1977–93; 7165 alcoholic cirrhosis (5079 men, 2086 women); case ascertainment, Danish Cancer Registry (100%)	Alcoholic	135	**SIR** 2.1 (1.8–2.5)	Age, sex, calendar period	Estimate not adjusted for smoking; reference, national incidence rates

Table 2.50 (continued)

Reference, location, name of study	Cohort description	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Boffetta *et al.* (2001), Sweden, Cohort of Alcoholics	173 665 (138 195 men, 35 470 women) patients with a hospital discharge of alcoholism, aged ≥20 years; mortality follow-up, 1965–95; case ascertainment 98% (National Cancer Registry)	*Alcoholic* Men Women Total	 1613 267 1880	**SIR** 2.2 (2.1–2.4) 4.2 (3.7–4.7) 2.4 (2.3–2.5)	Age, gender, calendar year	Estimates not adjusted for smoking; SIRs by histological type reported; reference, national incidence rates

CI, confidence interval; SIR, standardized incidence ratio; SMR standardized mortality ratio

Table 2.51 Cohort studies of total alcoholic beverage consumption and lung cancer in the general population

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Klatsky *et al.* (1981), California, USA, Kaiser-Permanente Study	8060 Kaiser-Permanente members who completed the self-administrated questionnaire; four groups of 2015 by level of alcoholic beverage drinking; follow-up, 1964–68 to 1976; cause-specific mortality ascertainment, California death index (82–92% death catchments)	Self-administered questionnaire	*Drinks/day* 0 ≤3 3–5 ≥6 ≥6 versus ≤2	 15 7 16 24	**SMR** [1.0] [0.6] [1.1] [1.7] $p<0.01$	Matched on sex, race, presence or absence of established cigarette smoking habit, examination date, age	Matching on smoking based on intensity; subjects were not removed if smoking habit could not be matched.

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Kvåle *et al.* (1983), Norway, Three cohorts	16 713 subjects from three different cohorts who responded to a mailed questionnaire: 1. 7966 men from general population sample; 2. 3409 men from sibling roster of migrants to the USA; and 3. family members of patients in a case–control study (2410 men, 2928 women); follow-up, 1967–69 to 1978; cancer case ascertainment, Cancer Registry of Norway; 67% histologically confirmed as primary tumour: response rate, ~80%	Mailed questionnaire	*Men* Low Medium High	 24 33 10	 1.0 Not provided 1.3 (p=0.37)	Age, cigarette smoking (never, former and current smokers of 1–9, 10–19 and ≥20 cigs/day), region, urban/ rural place of residence, socioeconomic group	Analysis for 10 602 men with information on smoking; interaction between alcoholic beverage and vitamin A intake statistically significant (p<0.05); definitions for low, medium and high alcohol intake not provided

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Pollack *et al.* (1984), Hawaii, Japan-Hawaii Cancer Study	8006 Japanese men born between 1900 and 1919 (also subjects for the Honolulu Heart Study); follow-up, 1965–68 to 1980; 100% case catchments; cancer case ascertainment, hospital records, death certificates and the Hawaii Tumor Registry; 100% histologically confirmed	Baseline interview questionnaire	**Type of beverage** *Beer* *Wine* *Liquor*	Not provided	 See Table 2.55 See Table 2.57 See Table 2.59	Age, cigarette-smoking status (never, former and current smokers), alcohol content of the other two types of beverage (if significant)	Association between total alcoholic beverage consumption and risk for lung cancer not available; no significant interaction between cigarette smoking and alcoholic beverage consumption found; updated analysis in Stemmermann *et al.* (1990);

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Kono *et al.* (1986), western Japan, Cohort of Male Japanese Physicians	5135 male physicians in western Japan; follow-up, 1965–83; vital status, 99%; cancer death ascertainment, death certificate; response rate, 51%	Baseline mailed questionnaire	Non-drinker Former drinker Occasional drinker *Daily drinker* <27 mL alcohol/ day ≥ 27 mL alcohol/ day per 27 mL/day	24 5 12 17 16 	1.0 0.6 (0.2–1.5) 0.4 (0.2–0.8) 0.8 (0.4–1.4) 0.9 (0.5–1.7) [0.9] [0.7–1.1]	Age, smoking (non-, former and current smoker consuming <10, 10–19 or >20 cigs/day)	

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Stemmermann *et al.* (1990), Hawaii, Japan-Hawaii Cancer Study	7572 Japanese men born between 1900 and 1919 (also subjects for the Honolulu Heart Study); follow-up, 1965–68 to 1989; 100% case catchments; cancer case ascertainment, hospital records, death certificates, and the Hawaii Tumor Registry; cancer diagnoses not histologically confirmed excluded	Baseline interview questionnaire	*Alcohol (oz/ month)* 0 <5 5–14 15–39 ≥40	209	 1.0 0.8 (0.5–1.2) 0.9 (0.6–1.5) 1.4 (1.0–2.1) 1.1 (0.7–1.6) *p* for trend=0.09	Age, current smoking status (never, former, current smokers), age started smoking (current smokers), number of cigarettes smoked per day (current smokers), maximum number of cigarette smoked per day (former smokers), years of smoking with maximum number per day (former smokers)	Risk for lung cancer found not to be influenced by the type of alcoholic beverage consumed 1 oz = 0.0296 L

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Chow *et al.* (1992), USA, Lutheran Brotherhood Insurance Society	17 818 white men, aged ≥35 years, life insurance policy holders of the Lutheran Brotherhood Insurance Society; follow-up, 1966–86; vital status, 77%; case ascertainment, death certificate; response rate, 69%	Mailed questionnaire at baseline	**Times/month** *Beer* *Liquor*		 See Table 2.55 See Table 2.59	Age, industry/ occupation, smoking status (never tobacco, other tobacco only, occasional/ past daily cigarette use of 1–19, 20–29, ≥30, current daily cigarette use of 1–19, 20–29, ≥30)	Relative risk for total alcoholic beverage consumption and risk for lung cancer not available
Potter *et al.* (1992), Iowa, USA, Iowa Women's Health Study	41 837 women, aged 55–69 years, drawn from the 1985 driver's licence list and responded to a mail survey in 1986; follow-up, 1986–88; cancer case ascertainment, Health Registry of Iowa, 100%; nested case–control study; controls randomly selected from the non-patient population; response rate, 43%	Mailed questionnaire	**Glasses/day** *Beer* *Liquor*		 See Table 2.55 See Table 2.59	Smoking (pack–years)	Nested case–control study; odds ratio for total alcoholic beverage consumption not available

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Doll *et al.* (1994), United Kingdom, British Male Doctors Study	12 321 male physicians born between 1900 and 1930 and returned the 1978 questionnaire; follow-up, 1978–91; cause-specific mortality ascertainment, death certificates	Mailed questionnaire	*Units/week* None 1–7 8–14 15–21 22–28 29–42 ≥ 43 *χ^2 test value of alcohol effect* None versus 1–14 Trend*	163	**Mortality ratio** [1.0] [1.6] [1.4] [0.9] [0.9] [1.3] [2.1] 0.9 (p>0.05) 0 (p>0.05)	Mortality standardized for age, smoking (never smokers, current smokers of 1–14, 15–24, 25 or more cigs/day, other current smokers, former smokers), year of death, history of previous disease	Relative risk for alcohol use on lung cancer mortality not given; mortality ratio calculated from the standardized mortality given in paper * Trend of 1–14 versus 15–28 versus ≥29 units/ week
Murata *et al.* (1996), Japan, Chiba Gastric Screening Cohort	17 200 men who participated in Chiba gastric screening in 1984; follow-up, 1984–93; cancer case ascertainment, Chiba Cancer Registry; histological confirmation not given; nested case–control study	Self-administered questionnaire at baseline (prior to screening)	*Cups/day (27 mL ethanol/day)* 0 0.1–1.0 1.1–2.0 ≥ 2.1	 38 28 31 10	 1.0 1.0 [0.6–1.8] 2.4 [1.3–4.4] 1.8 [0.7–4.5]	Age, sex, city/ county of address	Nested case–control study; controls individually matched 2:1 to cases by age, sex, city/county of address; odds ratio for alcoholic beverage drinking by smoking status reported

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Omenn *et al.* (1996), USA, β-Carotene and Retinol Efficacy Trial	Randomized, double-blinded, placebo controlled trial; 14 254 smokers (7982 men, 6272 women) and 4060 men occupationally exposed to asbestos; recruiting period, 1988–1994; end of study, 1995; case ascertainment, participant report and clinical record review; 81% histologically confirmed	Self-reported, collected routinely	**Placebo group** *Non-drinkers* *Drinkers* Below median alcoholic beverage intake 3rd quartile of intake 4th quartile of intake >30 g/day alcohol >50 g/day alcohol	63 16 39 29 20 9	[1.0] [0.6] [0.9] [0.7] [0.8] [0.8]	Crude incidence rate ratio	Adjusted relative risk not provided; median alcohol intake for men, 3.0 g/day; 75th percentile, 18.7 g/day; median alcohol intake for women, 1.2 g/day; 75th percentile, 11.1 g/day

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Omenn *et al.* (1996) (contd)			**Intervention group**				
			Non-drinkers	68	[1.0]		
			Drinkers				
			Below median alcoholic beverage intake	29	[1.0]		
			3rd quartile of intake	35	[0.7]		
			4th quartile of intake	64	[1.3]		
			>30 g/day alcohol	43	[1.4]		
			>50 g/day alcohol	21	[1.4]		
Bandera *et al.* (1997), New York, USA, New York State Cohort	48 000 (27 544 men and 20 456 women) long-term residents of New York State; follow-up, 1980–87; case ascertainment, New York State Cancer Registry	Mailed questionnaire at baseline	**Drinks/month**			Age, education, cigarettes/ day, years of smoking, total energy intake	Tertile range not reported
			Men				
			1st tertile	124	1.0		
			2nd tertile	95	0.8 (0.6–1.0)		
			3nd tertile	176	1.1 (0.9–1.4) *p* for trend=0.001		
			Women				
			1st tertile	34	1.0		
			2nd tertile	43	1.2 (0.7–1.8)		
			3nd tertile	53	1.0 (0.6–1.6) *p* for trend=0.80		

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Yong *et al.* (1997), USA, First National Health and Nutrition Examination Survey Epidemiologic Follow-up Study	10 068 subjects; follow-up, 1971–75 to 1992; follow-up, 96%; cancer case ascertainment, hospital records and death certificate	Baseline interview	Non-drinkers >5 g/day	Not given	1.0 1.2 (0.9–1.6)	Age, smoking status and pack–years smoked (8 categories), race, education, physical activity, body-mass index, total calorie intake	Alcoholic beverage consumption not the main focus of this study
Zhang *et al.* (1997) Zoucheng, Shandong, China	7809 men and 7994 women from probabilistic sample of general population in three counties, aged >20 years; mortality follow-up, 1982–94; cause-specific mortality ascertainment, county disease prevention and control centre	Baseline questionnaire, interviewer-administered	*Drinking/ smoking* No/No Yes/No No/Yes Yes/Yes	 1.0 3.1 4.2 2.5		Crude relative risk	No dose–response found for frequency, amount or duration of drinking; lung-cancer mortality found in crude analyses

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Prescott *et al.* (1999), Copenhagen, Denmark Three longitudinal population studies	Conducted in 1964–94: the Copenhagen City Heart Study, the Centre of Preventive Medicine, and the Copenhagen Male Study; 28 160 (15 107 men, 13 053 women) included; cancer follow-up, 99% (Danish Cancer Registry); response rate, 77%	Self-administered questionnaire	**Drinks/week** *Men* <1 1–6 7–13 14–20 21–41 >41 *Women* <1 1–6 7–13 14–20 21–41 >41	 52 85 106 65 114 58 63 82 30 11 7 1	 1.0 0.9 (0.6–1.2) 1.0 (0.7–1.4) 0.9 (0.6–1.3) 1.2 (0.9–1.7) 1.6 (1.1–2.3) *p* for trend=0.002 1.0 0.9 (0.6–1.3) 1.0 (0.6–1.6) 1.0 (0.5–1.9) 1.0 (0.5–2.2) 0.8 (0.1–5.8) *p* for trend=0.94	Age, study cohort, education, smoking (current smoking: pack–years, duration of smoking)	No interaction between smoking and total consumption or type of alcoholic beverage found

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Woodson *et al.* (1999), southwestern Finland, α-Tocopherol β-Carotene Cancer Prevention Study	27 111 white male smokers, aged 50–69 years in southwestern Finland; cancer incidence follow-up, 1985–94; cancer case ascertainment, Finland Cancer Registry and the Register of Causes of Death; 100% case ascertainment; 93% histologically confirmed; response rate, 93%	Self-administered food-use questionnaire at baseline	*Ethanol (g/day)* Non-drinkers Q1 0.04–5.2 Q2 5.3–13.3 Q3 13.4–27.6 Q4 27.7–278.5	1059 154 233 234 208 230	 1.2 (0.9–1.4) 1.0 1.0 (0.8–1.2) 0.9 (0.8–1.1) 1.0 (0.8–1.2) *p* for trend=0.89	Age, body-mass index, years smoked, cigarettes per day, intervention group	Relative risk for alcoholic beverage drinking, reported also by type of alcoholic beverage and by smoking categories
Breslow *et al.* (2000), USA, National Health Interview Survey	Sub-cohort of 20 004 adults, 18 years or older, who completed the Cancer Epidemiology Supplement (8363 men, 11 641 women); follow-up, 1987–95; case ascertainment, National Death Index and Death certificate; response rate, 86%	Cancer Epidemiology Supplement questionnaire (in-home interview)	*Servings/week* Q1 0 Q2 0.02–0.5 Q3 0.5–4.4 Q4 >4.4	 52 23 32 50	 1.0 0.7 (0.4–1.3) 1.0 (0.6–1.6) 1.3 (0.8–2.0) *p* for trend <0.101	Age, gender, smoking duration (years), packs per day smoked	Deaths arising within the first year of follow-up excluded

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Lu *et al.* (2000a), Yunnan, China, Cohort of Yunnan Tin Corporation Miners	7965 miners followed between 1992 and 1997, aged ≥40 years; 10 years of high-risk professional activity; completed the baseline questionnaire; did not have lung cancer; cases identified by expert panel	Interviewer-administered questionnaire	*Alcohol (g/day)* Non-drinkers <50 50–99 ≥100	 137 29 62 71	 1.0 1.0 (0.7–2.0) 1.4 (1.0–1.9) 1.5 (1.1–2.0)	Age, employment history, smoking	[From abstract and tables]

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Djoussé *et al.* (2002), Massachusetts, USA, Framingham Cohort Study (1948) and Framingham Offspring Study (1971)	In 1948, 5209 subjects aged 28–62 years at first examination; in 1971, 5124 children of the original cohort participated; study included 4265 subjects from the original cohort and 4973 from the offspring cohort; mean follow-up: original cohort, 32.8 years; offspring cohort, 16.2 years; cancer case ascertainment, self-report, hospitalization surveillance and National Death Index; 100% histologically confirmed	Follow-up examination	*Average intake (g/day)* 0 0.1–12 12.1–24 >24	269 44 100 39 86	 1.0 1.2 (0.7–2.1) 1.1 (0.6–2.1) 1.3 (0.7–2.4)	Age, sex, smoking status, pack–years of cigarette smoking, year of birth	Nested case–control study; controls selected using the risk–set sampling method and matched by age, pack–year of cigarette smoking, sex, year of birth, smoking status; for former smoker cases, controls also matched by year since quitting smoking

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Korte *et al.* (2002), USA, Cancer Prevention Study (CPS) I and II	Pooled analysis including unpublished results from the CPS I and II; CPS I, 379 575 men, 489 741 women; CPS II, 226 871 men, 230 552 women		**Ethanol (g/ month)**	Not provided		Smoking	
			CPS I				
			Men				
			Non-drinker		1.0		
			1–499		0.9 (0.8–1.0)		
			500–999		1.0 (0.9–1.1)		
			1000–1999		1.2 (1.1–1.3)		
			≥2000		1.4 (1.2–1.6)		
			Women				
			Non-drinker		1.0		
			1–499		1.0 (0.8–1.2)		
			500–999		1.2 (0.9–1.6)		
			1000–1999		1.8 (1.3–2.3)		
			≥2000		2.3 (1.4–3.9)		
			CPS II				
			Men				
			Non-drinker		1.0		
			1–499		0.9 (0.8–1.0)		
			500–999		1.0 (0.9–1.2)		
			1000–1999		1.0 (0.9–1.1)		
			≥2000		1.2 (1.0–1.4)		
			Women				
			Non-drinker		1.0		
			1–499		0.9 (0.8–1.1)		
			500–999		1.1 (0.9–1.3)		
			1000–1999		1.3 (1.0–1.5)		
			≥2000		1.1 (0.8–1.5)		

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Korte *et al.* (2002) (contd)	Meta-analysis of cohort studies including 8 published studies and unpublished data from CPSI and CPSII		*Ethanol (g/ month)* Non-drinker 1–499 500–999 1000–1999 ≥2000		 1.0 1.0 (0.9–1.0) 1.0 (0.9–1.1) 1.2 (1.0–1.3) 1.4 (1.2–1.6)	Smoking	
Balder *et al.* (2005), Netherlands, Netherlands Cohort Study on Diet and Cancer	58 279 men in 204 municipalities in Netherlands, aged 55–69 years; cancer follow-up, 1986–95; case ascertainment, Netherlands Cancer Registry and Netherlands Pathology Registry; case–cohort design (2335 men randomly sampled from the large cohort)	Mailed questionnaire	*Median intake (g/day)* Q1 0 Q2 2.2 Q3 9.3 Q4 23 Q5 42	 183 241 337 333 311	 1.0 1.1 (0.8–1.5) 1.2 (0.9–1.7) 1.1 (0.8–1.5) 1.6 (1.1–2.2) *p* for trend=0.03	Age, total energy intake (kJ), current cigarette smoker (yes/no), number of cigarettes smoked per day, years of smoking cigarettes, higher vocational or university education, family history of lung cancer, physical activity, body-mass index	

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Freudenheim *et al.* (2005), pooled analysis of 7 prospective studies	α-Tocopherol β-Carotene Cancer Prevention Study (men), Canadian National Breast Screening Study (women), Health Professional Study (men), Iowa Women's Health Study (women), Netherlands Cohort Study (women and men), New York State Cohort (women and men), Nurses' Health Study (women); total, 399 767 participants (137 335 men, 262 432 women)	Diet assessment by questionnaire	**Intake (g/day)** *Men* None >0–<5 5–<15 15–<30 ≥30 *Women* None >0–<5 5–<15 15–<30 ≥30	 254 373 432 324 379 467 344 252 130 182	**Pooled relative risk** 1.0 0.9 (0.7-1.0) 1.0 (0.8-1.2) 0.8 (0.6-1.1) 1.2 (0.9-1.6) *p* for trend=0.03 1.0 0.8 (0.7-0.9) 0.8 (0.7-1.0) 0.9 (0.7-1.1) 1.2 (0.9-1.4) *p* for trend=0.03	Education, body-mass index, energy intake, smoking status (never, past, current), smoking duration for past and current smokers, cigarettes smoked daily for current smokers; for specific alcoholic beverage, other two alcoholic beverage types were also adjusted in the model	Pooled relative risk for histological type reported; relative risk for alcohol drinking by smoking status reported; study-specific relative risk reported

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Nishino *et al.* (2006), Japan, Japan Collaborative Cohort	110 792 inhabitants, aged 40–79 years, of 45 study areas throughout Japan; follow-up, 1988–99; 28 536 men included in the analysis	Self-administered questionnaire at baseline	Never drinkers	91	1.0	Age, smoking (current smoking: 6 categories of number of pack–years; former smoking: 5 categories for number of years since quitting), family history of lung cancer, intake of green vegetables, oranges and fruit other than oranges	Analysis for men only; relative risks by smoking status reported
			Ever drinkers	286	1.0 (0.7–1.3)		
			Current drinkers (ethanol g/day)				
			24.9	113	0.8 (0.6–1.1)		
			25.0–49.9	85	0.9 (0.6–1.3)		
			50.0	38	1.0 (0.6–1.5)		
					p for trend = 0.32		
			Former drinkers	50	1.7 (1.2–2.5)		

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Rohrmann *et al.* (2006), 10 European countries, European Prospective Investigation into Cancer and Nutrition	521 457 from 10 European countries; most study centres recruited from the general population; other sources of recruitment included members of insurance plans, blood donors, mammographic screening, employees of enterprises, civil servants; 478 590 subjects included in the analysis (142 798 men, 335 792 women); baseline, 1992–2000; end of follow-up, 1999–2003; cases ascertainment, cancer registry and active follow-up; 97% histologically confirmed	Dietary instruments developped specifically for each country	**Ethanol (g/day)** *Both genders* Intake at recruitment Non-drinker 0.1–4.9 5–14.9 15–29.9 30–59.9 ≥60 Mean lifelong intake Non-drinker 0.1–4.9 5–14.9 15–29.9 30–59.9 ≥60	 146 310 232 169 184 78 30 228 229 201 117 82	 1.22 (1.0–1.5) 1.0 0.8 (0.6–0.9) 0.8 (0.7–1.0) 1.0 (0.8–1.2) 0.9 (0.7–1.1) *p* for trend=0.31 1.0 (6.7–1.5) 1.0 0.8 (0.7–1.0) 1.0 (0.8–1.2) 0.9 (0.7–1.1) 1.3 (0.9–1.7) *p* for trend=0.12	Results stratified by age, sex, study centre; hazard ratios adjusted for smoking status, smoking duration, height, weight, fruit consumption, red meat consumption, processed meat consumption, education, physical activity at work, total non-ethanol energy intake	Relative risks reported by histological type and by smoking status; interaction *p*-value reported

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Rohrmann *et al.* (2006) (contd)			*Men*				
			Intake at recruitment				
			Non-drinker	61	1.1 (0.8–1.6)		
			0.1–-4.9	121	1.0		
			5–14.9	118	0.7 (0.5–0.9)		
			15–29.9	108	0.8 (0.6–1.0)		
			30–59.9	128	0.9 (0.7–1.1)		
			≥60	70	0.8 (0.6–1.1)		
			Mean lifelong intake				
			Non-drinker	9	1.4 (0.7–2.9)		
			0.1–4.9	57	1.0		
			5–14.9	106	0.8 (0.5–1.1)		
			15–29.9	135	0.9 (0.7–1.3)		
			30–59.9	104	0.8 (0.6–1.2)		
			≥60	80	1.2 (0.8–1.8)		
			Women				
			Intake at recruitment				
			Non-drinker	85	1.3 (1.0–1.7)		
			0.1–4.9	189	1.0		
			5–14.9	114	0.8 (0.6–1.0)		
			15–29.9	61	0.9 (0.7–1.2)		
			30–59.9	56	1.1 (0.8–1.5)		
			≥60	8	0.9 (0.4–1.8)		

Table 2.51 (continued)

Reference, location, name of study	Cohort description	Exposure assessment	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)	Adjustment factors	Comments
Rohrmann *et al.* (2006) (contd)			Mean lifelong intake				
			Nondrinker	21	0.9 (0.5–1.4)		
			0.1–4.9	171	1.0		
			5–14.9	123	0.8 (0.7–1.1)		
			15–29.9	66	1.1 (0.8–1.5)		
			30–59.9	13	0.9 (0.5–1.6)		
			≥60	2	1.3 (0.3–5.5)		

CI, confidence interval; oz, ounce (1 oz = 29.6 mL); SIR, standardized incidence ratio; SMR, standardized mortality ratio

A meta-analysis (Korte *et al*., 2002) found a significantly increased risk for lung cancer with an ethanol intake of at least 2000 g per month (≥5 drinks/day): the weighted odds ratio from case–control studies was 1.5 (95% CI, 1.0–2.3) and the weighted relative risk from cohort studies was 1.4 (95% CI, 1.2–1.6). [The weighted odds ratio for case–control studies was based on only one study and the relative risk for cohort studies on only three studies. These results should therefore be interpreted with some caution.]

It should be noted that most studies examined the effects of recent drinking patterns (case–control studies) or of the drinking patterns at baseline (cohort studies). The exposure studied most extensively was the frequency of drinking. Other parameters of exposure to alcoholic beverages, such as duration and age at initiation of drinking and the relevant exposure period, were not reported.

(c) Case–control studies (Table 2.52)

Twenty-one case–control studies reported tobacco smoking-adjusted odds ratios for total alcoholic beverage consumption and the risk for lung cancer. Four of the seven population-based studies (Carpenter *et al*., 1998; Hu *et al*., 2002; Freudenheim *et al*., 2003; Benedetti *et al*., 2006) reported no significant association between any level of alcoholic beverage consumption examined and the risk for lung cancer. However, most of them used categories that reflected a relatively low level of drinking (e.g. 1 drink/day or less often; highest level of drinking, >2 drinks per day, but the median frequency for this category was unclear). Three hospital-based studies (De Stefani *et al*., 1993; Dosemeci *et al*., 1997; Rachtan, 2002) that used non-drinkers as the baseline comparison group found a significant association between consumption of more than one drink per day and the risk for lung cancer. Dosemeci *et al*. (1997) found an elevated risk for lung cancer and a dose–response with increasing frequency of consumption, duration of drinking and cumulative measures in bottle–years. One hospital-based study (Zang & Wynder, 2001) did not find an association for cumulative alcoholic beverage intake (frequency×duration), or for ≥7 oz of 'whiskey-equivalents' of alcohol per day [approximately ≥68 g of ethanol per day] (odds ratio, 1.1; 95% CI, 1.0–1.4). [The Working Group noted that the baseline comparison group in this study included people who consumed less than one alcoholic beverage per day.] De Stefani *et al*. (2002) also reported a null association for adenocarcinoma of the lung.

In addition, among nine case–control studies of lung cancer published in the Chinese literature, five adjusted for or stratified by tobacco smoking. Five studies reported a positive association between alcoholic beverage consumption and the risk for lung cancer and point estimates that ranged from 1.5 to 6.6 but none reported the levels of consumption.

Table 2.52 Case–control studies of total alcoholic beverage consumption and lung cancer risk in the general population

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Williams & Horm (1977), USA, 1969–71	7518 (3436 men, 3856 women for the alcohol and tobacco smoking analysis) from Third National Cancer Survey (TNCS); age range not given; histological confirmation unclear; response rate, 57%	Intracancer controls from TNCS; patients with cancers thought to be unrelated to tobacco and alcohol use	Personal interview	**Oz/week × years** *Men* Non-drinker <51 ≥51 *Women* Non-drinker <51 ≥51	 1.0 p>0.05 0.9 p>0.05 1.0 p>0.05 1.0 p>0.05 1.1 p>0.05 0.7 p>0.05	Age, race, smoking	Controls included colon and liver cancer; non-drinkers defined as those who never drank at least once a week for 1 year; odds ratios for alcoholic beverage types reported
Herity *et al.* (1982), Ireland	59 men [patients at St Luke's hospital in Dublin], aged 44–83 years; histological confirmation unclear; response rate not given	152 male cancer patients, source not described, aged 21–83 years; response rate not described	Structured questionnaire in interview	Non-drinkers or ≤90 g of alcohol/day for 10 years >90 g of alcohol/day for 10 years	1.0 1.5 (0.4–5.2)	Stratified for non- or light smokers (≤20 cigs/day for 43 years)	Controls included cancer of gastrointestinal tract; interaction between alcohol drinking and smoking reported

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Kabat & Wynder (1984), USA, 1971–80	134 (37 men, 97 women) never-smoking patients; 100% histologically confirmed; response rate not given	134 (37 men, 97 women) hospitalized with non-tobacco-related diseases; individually matched to cases by age, sex, race, hospital, date of interview (±2 years), non-smoking status; response rate not given	In-hospital interview with a standardized questionnaire	No significant differences in alcohol intake were found between cases and controls of either sex (no numbers reported)			Nonsmoker defined as someone who had never smoked as much as one cigarette, pipe or cigar per day for a year; most controls had a cancer diagnosis (~60%).
Koo (1988), Hong Kong, China, 1981–83	88 never-smoking hospitalized Chinese women; age not given; 100% histologically confirmed; response rate not given	137 never-smoking Chinese women in the community; individually matched by district, house type before the exclusion of ever smokers	In-hospital (cases) or in-home (controls) interview	<1 time/week ≥1 time/week	1.0 1.9 (0.9–3.7) *p* for trend =0.076	Age, no. of live births, schooling	Never smokers were defined as those who had smoked less than 20 cigarettes or pipes in the past; odds ratio by histological type reported.

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Mettlin (1989), New York, USA, 1982–87	569 (355 men, 214 women) hospitalized, aged 35–90 years; 100% histologically confirmed; response rate not given	569 cancer-free hospitalized; matched on age, sex, residence	Self-administered questionnaire	**Times/week** *Beer* *Wine* *Liquor*	 See Table 2.56 See Table 2.58 See Table 2.60	Age, residence, sex, smoking history [probably pack–years], β-carotene intake index, education	Odds ratio for total alcoholic beverage consumption not available
Pierce *et al.* (1989), Melbourne, Australia, 1984–85	71 hospitalized men; mean age, 67.3 years; 100% cytologically or histologically confirmed; response rate; 100%	70 hospitalized cancer-free men; mean age, 66.5 years; individually matched to cases by age (±5 years); response rate, 100%	In-hospital interview	Drinks/week Duration (years)	1.0 (0.99–1.01) 1.0 (0.96–1.03)	Age; not clear whether smoking was adjusted	[The Working Group noted methological concerns and inconsistencies in the article]

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Bandera *et al.* (1992), New York, USA, 1980–84	280 hospitalized white men, aged 35–79 years; 100% histologically confirmed	564 neighbourhood controls; matched on age, sex, neighbourhood; response rate, 42%	In-person interview at home	**Total alcohol (1 year prior)** *0–40 pack–years* 0–21 drinks/ month ≥22 drinks/ month *p* for trend=0.1 *≥41 pack–years* 0–21 drinks/ month ≥22 drinks/ month *p* for trend=0.03	 1.0 0.9 (0.6–1.6) 1.0 1.6 (1.0–2.5)	Age, education smoking (pack–years)	Odds ratios for alcoholic beverage types reported; categories of alcoholic beverage consumption were based on distribution in combined sample of cases and controls

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
De Stefani *et al.* (1993), Uruguay, 1988–90	327 hospitalized men, aged 25–84 years; 100% histologically confirmed; response rate, 100%	350 men hospitalized with non-neoplastic condition (non-alcohol- related) as well as non-tobacco-related cancer, aged 25–84 years; response rate, 100%	Interviewer-administered questionnaire	*Ethanol (mL/day)* Lifetime abstainers 1–60 61–176 >176	 1.0 1.4 (0.9–2.0) 1.6 (0.9–2.0) 2.2 (1.3–3.0) *p* for trend =0.002	Age, residence, education, smoking (pack–years); for specific alcoholic beverages, other types of alcoholic beverage also controlled for	Histological type examined but data not reported; odds ratios for alcoholic beverage types reported; odds ratios for alcohol drinking by smoking status reported; tertile cut-off points for alcohol consumption based on the distribution in the combined sample of cases and controls; only one nonsmoking case

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Mayne *et al.* (1994), New York, USA, 1982–85	413 (212 men, 201 women) nonsmokers identified via the medical records department, pathology department and the tumour registry, aged 31–80 years; 99% histologically confirmed; interview conducted for 76% of all eligible	413 population selected from driving license files; individually matched on age, sex, county of residence, smoking history; response rate: two potential controls had to be contacted to obtain one control for the case, on average	Interviewer-administered questionnaire (home interview, food-frequency questionnaire for alcohol use)	Beer /month Q1 Q2 Q3 Q4	 1.0 (ref) 1.1 (p>0.05) 0.9 (p>0.05) 1.2 (p>0.05)	Age, sex, county of residence, smoking history, cigs/day smoked by former smokers, religion, education, body-mass index, income	Nonsmokers included never smokers and former smokers; 44% of cases were never smokers; one-third of case–control pairs used proxy respondents; passive smoking was found not to confound the dietary association and was therefore not included in the final model; odds ratio for total alcoholic beverage consumption not available

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Dosemeci *et al.* (1997), Istanbul, Turkey, 1979–84	1210 hospitalized men; 67% histologically confirmed; response rate not given (information obtained by hospital at time of admission)	829 hospitalized men including selected cancers reported not to be related to smoking or alcohol use, and subjects found to have no cancer	Standardized data-collection instrument at time of admission	Never drinker Ever drinker *Alcohol/week* 1–35 cL 36–140 cL >140 cL *Duration* 1–10 years 11–20 years >20 years *Bottle–years (35 cL of hard liquor)* 1–34 35–90 >90	1.0 1.6 (1.2–2.1) 1.6 (0.8–2.9) 1.7 (1.1–2.7) 1.7 (1.0–2.9) *p* for trend <0.001 1.8 (0.9–3.5) 1.6 (1.0–2.7) 2.1 (1.0–4.5) *p* for trend =0.001 1.7 (0.9–3.0) 1.9 (1.0–3.7) 1.6 (0.9–3.0) *p* for trend =0.004	Age, smoking (pack–years)	Interaction between alcoholic beverage drinking and smoking reported; odds ratio for specific histological type reported; odds ratio among smokers only reported
Rachtan & Sokolowski (1997), Cracow, Poland, 1991–94	118 hospitalized women; age not reported; 100% histologically confirmed; response rate not given	141 healthy women selected among next of kin of patients admitted to the same hospital without tobacco-related cancer; age not given; response rate not given	Interviewer-administered structured questionnaire	**Frequency** *Beer* *Wine* *Vodka*	 See Table 2.56 See Table 2.58 See Table 2.60		Odds ratios for total alcoholic beverage consumption not available; updated analysis in Rachtan (2002)

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Carpenter *et al*. (1998), Los Angeles, USA, 1991–94	261 (153 men, 108 women) hospitalized, aged 40–84 years; 100% histologically confirmed; response rate, [69%]	615 (416 men, 199 women) population; frequency matched for age, gender, race; response rate, [50%]	In-person interview	*Recent consumption* Never to 3 drinks/month 1–6 drinks/week 1–2 drinks/day >2 drinks/day *Consumption between age 30 and 40 years* Never to 3 drinks/month 1–6 drinks/week 1–2 drinks/day >2 drinks/day	 1.0 0.5 (0.3–0.8) 0.9 (0.5–1.5) 1.1 (0.5–2.5) *p* for trend =0.06 1.0 0.6 (0.4–1.0) 0.7 (0.4–1.2) 0.7 (0.3–1.4) *p* for trend =0.54	Age, gender, race, saturated fat consumption, tobacco smoking (pack–years), years since quitting tobacco smoking; for specific alcoholic beverages, other types of alcoholic beverages also controlled for in the model	Histological type-specific odds ratio reported; odds ratio for alcoholic beverage types reported; subjects were Caucasians and African-Americans; study restricted to subjects who had complete information on smoking, recent alcoholic beverage consumption, past alcohol consumption, diet; period for ‘recent consumption’ not defined

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Zang & Wynder (2001), 8 metropolitan areas, USA, 1969–94	1763 hospitalized men; age not given [probably <50–≥70 years]; histological confirmation not clear, > [87%] if not 100%; response rate not given	4436 hospitalized men (included non-tobacco-related cancers and non-neoplastic diseases; excluded patients diagnosed with alcohol-related illness); age not given; pair-matched on age, sex, race, hospital, time of hospital admission before applying the exclusion criteria; response rate not given	Interviewer-administered questionnaire (exposure starting at least 1 year prior to the current illness)	*Current pattern ('whiskey-equivalent' oz alcohol/day)* <1 1–3.9 4–6.9 ≥7 Continuous variable *Lifetime exposure ('whiskey-equivalent' oz alcohol drink per day × years of drinking)* <4 4–16 17–27 28–64 65–103 ≥104 Continuous variable	 1.0 1.1 (0.9–1.3) 1.2 (0.9–1.4) 1.1 (1.0–1.4) 1.1 (1.0–1.1) 1.0 1.0 (0.8–1.2) 1.2 (0.9–1.5) 1.1 (0.9–1.4) 1.2 (0.9–1.5) 1.1 (0.9–1.3) 1.0 (1.0–1.1)	Body-mass index, current no. of cigarettes smoked per day; for lifetime exposure to alcohol, age also adjusted	Caucasian only; odds ratios for specific histology reported; odds ratios for alcohol drinking by smoking categories reported

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
De Stefani *et al.* (2002), Montevideo, Uruguay, 1998–2000	160 hospitalized men, aged 30–89 years; 100% histologically confirmed adenocarcinomas; response rate, 97%	520 men hospitalized for non-tobacco-, non-alcohol-related non-neoplastic conditions; frequency-matched on age, residence, urban/rural status; response rate, 93%	In-person interview	*Ethanol (mL/day)* Non-drinkers 1–60 61–120 >120	 1.0 0.8 (0.4–1.5) 1.1 (0.6–2.1) 1.2 (0.6–2.1) *p* for trend =0.34	Age, residence, urban/ rural status, education, family history of lung cancer in first-degree relatives, body mass index, smoking status, cigarettes per day, years since quit, age started smoking	Adenocarcinoma only; drinkers were defined as those who ingested alcohol at least 1 day per week regularly; odds ratios for alcoholic beverage types reported
Hu *et al.* (2002), 8 provinces, Canada, 1994–97	161 never-smoking women from the Provincial Cancer Registry, aged 20–>70 years; 100% histologically confirmed; response rate, 62%	483 population-based cancer-free; frequency-matched by age, sex, province; response rate, 71%	Questionnaire mailed to cases and controls	*Servings/week* 0 1 >1	 1.0 0.8 (0.5–1.4) 0.8 (0.5–1.2) *p* for trend =0.25	10-year age groups, province, education, social class	Study restricted to never smokers; definition for never smoking not described; odds ratios for alcoholic beverage types reported

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Korte *et al.* (2002)	Meta-analysis on alcoholic beverage consumption and risk for lung cancer		No. of studies	*Ethanol (g/month)*	Pooled odds ratio	Smoking	Pooled odds ratios from case–control studies only (including studies presented in this table)
				Non-drinker	1.0		
			3	1–499	0.6 (0.5–0.8)		
			5	500–999	1.3 (1.0–1.7)		
			2	1000–1999	1.1 (0.5–2.8)		
			1	≥2000	1.9 (1.4–2.5)		
			7	Overall	1.4 (1.1–1.8)		
Pacella-Norman *et al.* (2002), Johannesburg, South Africa, 1995–99	146 (105 men, 41 women) hospitalized, aged 18–74 years; 90% confirmed by histology, heamotology or cytology; response rate not given	2174 (804 men, 1370 women) hospitalized with non-tobacco-related cancer, aged 18–74 years; response rate not given	Nurse-administered interview (questionnaire)	*Men*		Age, place of birth, education, work category, missing values, heating fuel, smoking and snuff use (smoking adjusted for past–current smoking, current smoking by cigs/day)	Subjects were black; controls included patients with colon cancer
				Non-drinkers	1.0		
				<1 time/week	0.3 (0.1–1.1)		
				1–3 times/week	0.7 (0.3–1.5)		
				Most days/week	0.7 (0.4–1.3)		
				Women			
				Non-drinkers	1.0		
				<1 time/week	1.3 (0.5–3.3)		
				1–3 times/week	0.8 (0.3–2.6)		
				Most days/week	0.8 (0.3–2.1)		

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Rachtan (2002), Cracow, Poland, 1991–97	242 hospitalized women; age range not given; 100% histologically confirmed; response rate not given	352 healthy women from next-of-kin of patients admitted to the same hospital without tobacco-related cancer; age not given; response rate not given	Interviewer-administered structured questionnaire	*Average vodka intake (g)* Non-drinkers <100 g ≥100 g	 1.0 2.2 (1.3–3.8) 7.8 (2.9–21.2) *p* for trend <0.001	Age, pack–years of smoking, passive smoking, siblings with cancer, tuberculosis, place of residence, occupational exposure to coal and other dusts, rubber, acid mist, solvents, metals, other chemicals, consumption of milk, butter, margarine, cheese, meat, fruit, vegetables, carrots, spinach	Odds ratios for vodka for histological type reported; odds ratios for total alcohol drinking by smoking status reported; estimates unadjusted for smoking for beer and wine intake reported

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Freudenheim *et al*. (2003), New York, USA, 1996–98	168 hospitalized (111 men, 57 women), aged 35–79 years; 100% histologically confirmed; response rate, 48%	3351 (1546 men, 1805 women) population, aged 35–79 years; frequency-matched for age, sex, race for cases in three case–control studies; response rate, 65%	Interviewer-administered questionnaire	*Lifetime consumption (L)* 0 ≤82 >82 *Recent consumption (previous 12–24 months)* 0 ≤2.5 >2.5	 1.0 1.1 (0.5–2.6) 1.1 (0.5–2.7) *p* for trend =0.44 1.0 1.0 (0.4–2.4) 1.4 (0.5–3.4) *p* for trend =0.41	Age, education, race, sex, body-mass index, vegetable intake, fruit intake, total energy intake excluding alcohol, packs smoked per year, years smoked, index of passive exposure to smoke at home, work and in other settings	Odds ratios for alcoholic beverage types reported; [discrepancy in number and sex of cases in paper]

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Gajalakshmi *et al.*(2003), Tamil Nadu and Kerala, India, 1993–99	778 men from two cancer centres, aged ≤34–≥75 years; 100% histologically confirmed; response rate not given	3430 men (1503 non-tobacco-related cancers, 1927 healthy) recruited from the two cancer centres, aged ≤34–≥75 years; response rate not given	Interviewer-administered standard questionnaire	*Total alcohol* Never Former Current *Non-Indian alcohol* Never Former Current *Indian alcohol* Never Former Current	 1.0 0.9 (0.7–1.3) 1.7 (1.3–2.1) 1.0 0.8 (0.5–1.2) 1.3 (1.0–1.7) 1.0 0.9 (0.6–1.3) 1.8 (1.4–2.4)	Age, education, centre, smoking pack–years	Cancer controls included colon cancer; alcohol drinkers defined as people who drink alcohol at least once a day for at least 6 months; former drinker defined as drinkers who had stopped drinking for more than 1 year before interview; odds ratios restricted to never smokers reported

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Ruano-Ravina *et al.* (2004), Northwest Spain, 1999–2000	132 (118 men, 14 women) hospitalized, mean age, 64.2 years; 100% histologically confirmed; response rate, 100%	187 (164 men, 23 women) hospitalized (non-tobacco-related minor surgery); mean age, 62.5 years; frequency-matched on sex; response rate, 100%	Interviewer-administered questionnaire	*Beer* *Wine* *Liquor*	See Table 2.56 See Table 2.58 See Table 2.60	Age, sex, occupation, smoking habit (total lifetime tobacco consumption in thousands of packs), total alcoholic beverage intake	Odds ratio for total alcoholic beverage consumption not available

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Benedetti *et al.* (2006), Montreal, Canada, Study I: early 1980s Study II: mid 1990s	Study I: 699 hospitalized men, aged 35–70 years; [100% histologically confirmed]; response rate, 65% Study II: 1094 (640 men, 454 women) hospitalized, aged 35–75 years; [100% histological confirmation]; response rate, 76%	Study I: 507 men population-based; frequency-matched by age, residence to all cancer cases (all cancer cases arise from the hospitals); response rate, 69% Study II: 1468 (861 men, 607 women) population-based; stratified to the age and sex distribution of cases; response rate, 67%	Interview (proxy was allowed)	*Study I men* <1 drink/week 1–6 drinks/week ≥7 drinks/week *Study II men* <1 drink/week 1–6 drinks/week ≥7 drinks/week *Study II women* <1 drink/week 1–6 drinks/week ≥7 drinks/week	 1.0 1.2 (0.8–1.8) 1.3 (0.9–1.9) 1.0 1.0 (0.7–1.4) 1.2 (0.9–1.8) 1.0 0.4 (0.2–0.5) 0.7 (0.5–1.1)	Age, smoking status, cigarette–years, time since quitting, respondent status, ethnicity, census tract income, years of schooling	Odds ratios for specific histological type reported; odds ratios for alcoholic beverage types reported; odds ratios for alcohol drinking by smoking categories reported (light, moderate, heavy); odds ratios based on median drink–year cut-off reported

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Studies in the Chinese literature							
Zhang *et al.* (1989), JinZhou, Liaoning, 1988–89	105 hospitalized; age, sex distribution not given; histological confirmation not given; response rate not given	210 hospitalized (105 cancer, 5 cancer-free); age, sex distribution not given; response rate: not given	In-hospital interview	*Alcohol drinking* No Yes		Alcohol drinking variable no longer significant after adjusting for smoking, chronic bronchitis, exposure to toxic substances, coal burning, depression, cooking, education, family history of cancer	No adjusted odds ratio for alcohol use reported
Zhang *et al.* (1990), Dandong, Liaoning, 1987–88	Six cause of deaths (including lung cancer) identified between 1987 and 1988, aged >17 years; proxy probably used for cases; response rate not given	Random sample of 2500–3000 from general population; source not well described; age not given; response rate not given	[Interview?]	*Drinking/ smoking* No/No Yes/No No/Yes Yes/Yes	 1.0 2.2 (0.5–10.3) 6.2 (1.8–20.9) 10.6 (3.3–34.5)	Urban/rural, sex, age	

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Zhang *et al.* (1992), Lanzhou, Gansu, 1982–88	70 (58 men, 12 women) hospitalized from 8 hospitals in Lanzhou for over 10 years, aged 21–77 years; 100% histologically confirmed; response rate not given	70 hospitalized; 1:1 matched on age, sex, occupation; response rate not given	Interviewer-administered questionnaire	*Alcohol drinking* No Yes	 1.0 2.3	Smoking, coal burning	95% CI or *p*-value not provided [although probably significant]
Cui *et al.* (2001b), Jiangyan, Jiangsu, 1995–96	181 male [hospitalized] survivors, aged 24–86 years; 76% histologically confirmed; response rate not given	181 men selected from the healthy relatives or neighbours who had lived in the same area or worked with cases; matched on age	Interviewer-administered questionnaire	*Alcohol drinking* No Yes	 1.0 2.3 (1.2–8.4)	Smoking, respiratory disease, depression, body-mass index	

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Zhang *et al.* (2002), Kunmin, Yunnan, NR	118 (91 men, 27 women) hospitalized, mean age, 58 years; 100% histologically confirmed; response rate not given	118 healthy; matched on sex, occupation, ethnic group, age, residence	Interviewer-administered questionnaire	*Alcohol drinking* No Yes		[Alcohol drinking variable not significant in multivariate analysis]	No adjusted odds ratio for alcohol use reported
Chen *et al.* (2003b), Tianjin, before 1996	193 (sex not given) hospitalized, aged 30–76 years; 68% histologically confirmed; response rate: not given	259 (sex not given) randomly selected from a community in Tianjin, aged 30–75 years; response rate not given	Interviewer-administered questionnaire	*Alcohol drinking* No Yes		Alcohol drinking variable no longer significant after adjusting for smoking	No adjusted odds ratio for alcohol use reported

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Chen *et al.* (2003c); Huang *et al.* (2004), Guangzhou, Guangdong, 2000–02	91 hospitalized; age and sex distribution not given; 100% histologically confirmed; response rate not given	138 (91 hospitalized non-cancers and 47 healthy employees of Guangdong Pharmacy School); residents of Guangdong; matched on age, sex; response rate not given	Questionnaire	*Alcohol drinking* No Yes No Yes No Yes	*All lung* 1.0 3.3 (1.7–6.4) *SCC* 1.0 3.9 (1.8–8.2) *AC* 1.0 2.5 (1.0–6.3)	Crude odds ratio	Subjects overlapped with Chen *et al.* (2004).
Wu *et al.* (2003); Chen *et al.* (2004), Guangzhou, Guangdong, 2000–01	91 (60 men, 31 women) incident hospitalized, aged 22–84 years; histological confirmation not given; response rate not given	91 (60 men, 31 women) hospitalized without cancer or pulmonary diseases; matched by age; response rate not given	Questionnaire	*Alcohol drinking* No Yes	1.0 6.6 (1.5–28.3)	Education, smoking (cigs/day), ventilation for cooking fume, consumption of animal oil, carrot intake, family history of lung cancer	Same subjects as in Chen, M.-X. *et al.* (2003)

Table 2.52 (continued)

Reference, study location, period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)	Adjustment factors	Comments
Zou *et al.* (2005), Dayao, Yunan, 1987–2001	53 cases (46 men, 7 women) identified by retrospective cohort, mean age, 62 years; histological confirmation not clear (all confirmed with histological or image diagnosis); response rate not given	159 from the cohort, aged ≥30 years; local residents; men age, 65 years; matched to cases (1:3 ratio) on age, sex, residence, education; response rate not given	Interviewer-administered questionnaire	*Alcohol drinking* No Yes	 1.0 1.2 (0.5–2.7)	Using asbestos stove, cigarette smoking, tea drinking	Nested case–control study Proxy respondent used for subjects who died; alcohol drinking variable not defined

AC, adenocarcinoma; CI, confidence interval; NR, non reported; SCC, squamous-cell carcinoma

2.10.2 *Histological type (Tables 2.53 and 2.54)*

Two cohort studies, one pooled analysis and seven case–control studies presented smoking-adjusted risk estimates for alcoholic beverages by histological type of lung cancer. There appears to be no consistent pattern for the effect estimates of alcoholic beverages on the main lung cancer types: squamous-cell carcinoma, adenocarcinoma and small-cell lung cancer (Tables 2.53 and 2.54). A positive association with squamous-cell carcinoma was reported in three case–control studies (Dosemeci *et al*., 1997; Zang & Wynder, 2001; Rachtan, 2002). A positive relationship between alcoholic beverage consumption and adenocarcinoma was reported in four case–control studies (Carpenter *et al*., 1998; Zang & Wynder, 2001 [lifetime exposure]; Rachtan, 2002; Benedetti *et al*., 2006 [only in men]). In a study in which only the cases of adenocarcinoma were included (De Stefani *et al*., 2002), no association was observed between alcoholic beverage consumption and this histological type, despite the large number of cases.

In a pooled analysis of seven cohort studies (Freudenheim *et al*., 2005), some association was found for adenocarcinoma and small-cell lung cancer among men, and for adenocarcinoma among women. In a more recent study that was not included in the pooled analysis (Rohrmann *et al*., 2006), virtually no association was observed for any lung cancer type among both men and women. [Estimates for lung cancer subtype were mostly based on small numbers of cases, which leads to difficulties in interpreting results due to wide confidence intervals and the possibility of chance findings.] Currently available data do not provide any conclusive evidence for the risk of alcoholic beverage intake on lung cancer subtype.

2.10.3 *Types of alcoholic beverage*

Findings from studies examining risk estimates for the consumption of different types of alcoholic beverages (i.e. beer, wine, and hard liquor) indicate that they may have different effects on lung cancer risk.

(a) Beer (Tables 2.55 and 2.56)

Among the six cohort studies that examined the effects of beer drinking on risk for lung cancer, two found a positive association for drinking one serving of beer per day in women (Potter *et al*., 1992) or two or more servings per day in men (Prescott *et al*., 1999) (Table 2.55). In the latter study, the point estimate for women was of similar magnitude as that in men (relative risk, 1.4 for men and 1.5 for women), but the confidence interval was wide (95% CI, 0.7–3.1).

In a pooled analysis that combined data from seven prospective cohort studies (Freudenheim *et al*., 2005), a positive association with a significant dose-reponse relationship was found between beer drinking and the risk for lung cancer among women, but not among men. The risk almost doubled for women who consumed ≥15 g ethanol

Table 2.53 Cohort studies of alcoholic beverage consumption and lung cancer by histological type

Reference	Subject and histology	Exposure categories	Risk ratio (95% CI)	Comments
Boffetta *et al.* (2001)	*Men*	Alcoholic	**SIR**	Adjusted for age, gender, calendar year; estimates not adjusted for smoking; SIR reference, national incidence rates; SCLC cases also included in 'other and unspecified type'
	SCC		2.4 (2.3–2.6)	
	AC		2.1 (1.9–2.4)	
	SCLC		1.1 (0.5–2.1)	
	Other and unspecified type		2.1 (2.0–2.3)	
	Women	Alcoholic		
	SCC		5.3 (4.1–6.8)	
	AC		3.3 (2.6–4.1)	
	SCLC		1.9 (0.4–5.6)	
	Other and unspecified type		4.4 (3.7–5.3)	
	Both genders	Alcoholic		
	SCC		2.6 (2.4–2.8)	
	AC		2.3 (2.1–2.5)	
	SCLC		1.2 (0.6–2.2)	
	Other and unspecified type		2.3 (2.2–2.5)	

Table 2.53 (continued)

Reference	Subject and histology	Exposure categories	Risk ratio (95% CI)						Comments
		Alcohol g/day	>0–<5	5–<15	15–<30	≥30	*p* for trend		
Freudenheim *et al.* (2005)	*Men*								Reference, 0 g/day; adjusted for education, body-mass index, energy intake, smoking status, smoking duration, cigarettes/day
	SCC		0.9 (0.7–1.2)	1.0 (0.8–1.3)	0.8 (0.6–1.2)	1.1 (0.5–2.1)	0.64		
	AC		1.1 (0.8–1.4)	1.2 (0.9–1.6)	1.0 (0.7–1.5)	1.4 (1.0–2.1)	0.10		
	SCLC		1.1 (0.8–1.5)	1.2 (0.9–1.6)	1.1 (0.8–1.5)	1.7 (1.2–2.3)	<0.01		
	Women								
	SCC		0.7 (0.5–1.1)	0.8 (0.6–1.0)	0.8 (0.6–1.2)	0.9 (0.6–1.5)	0.99		
	AC		0.9 (0.8–1.1)	0.9 (0.7–1.2)	1.0 (0.7–1.3)	1.4 (1.0–2.0)	<0.01		
	SCLC		0.8 (0.6–1.1)	0.8 (0.6–1.1)	1.0 (0.6–1.5)	0.9 (0.6–1.3)	0.94		
		Ethanol (g/day)	Non-drinker	5–14.9	15–29.9	30–59.9	≥60	*p* for trend	
Rohrmann *et al.* (2006)	*Men and women*								Reference, 0.1–4.9 g/day; all results stratified by age, sex, study centre; adjusted for smoking status, smoking duration, height, weight, consumption of fruit, red meat, processed meat, education, total non-ethanol energy intake
	SCC	Baseline intake	1.9 (1.2–2.9)	0.8 (0.6–1.2)	0.8 (0.5–1.3)	1.0 (0.6–1.5)	0.9 (0.5–1.6)	0.30	
	AC		1.1 (0.8–1.7)	0.9 (0.7–1.2)	1.1 (0.8–1.5)	1.3 (0.9–1.8)	1.2 (0.7–2.0)	0.19	
	SCLC		0.9 (0.5–1.6)	0.8 (0.5–1.2)	0.7 (0.4–1.1)	0.9 (0.5–1.4)	0.9 (0.5–1.7)	0.85	
	SCC	Mean lifelong intake	1.2 (0.5–2.8)	0.6 (0.4–0.9)	0.7 (0.5–1.2)	0.7 (0.4–1.2)	0.9 (0.5–1.8)	0.87	
	AC		1.0 (0.5–2.2)	0.9 (0.6–1.2)	1.3 (0.9–1.9)	1.1 (0.7–1.8)	1.4 (0.8–2.6)	0.16	
	SCLC		0.6 (0.1–2.6)	1.0 (0.6–1.6)	0.9 (0.6–1.6)	1.0 (0.5–1.9)	1.4 (0.7–2.8)	0.38	

AC, adenocarcinoma; CI, confidence interval; SCC, squamous-cell carcinoma; SCLC, small-cell lung cancer; SIR, standardized incidence ratio

Table 2.54 Case–control studies of alcoholic beverage consumption and lung cancer by histological type

Reference	Subject and histology	Exposure categories	Odds ratio (95% CI)				Comments
Koo (1988)		Times/ week	≥1	*p* for trend			Reference, <1 time/week; adjusted for age, no. of live births, schooling; restricted to never smokers
	Women						
	SCC + SCLC		2.1	0.141			
	AC + LCLC		1.4	0.460			
Dosemeci *et al.* (1997)	*Men*	Ever drank					Reference, never drinkers; adjusted for age, smoking
	SCC		1.6 (1.1–2.2)				
	SCLC		1.3 (0.8–2.1)				
	Others		1.9 (1.2–2.9)				
		Alcohol (cL/week)	1–35	36–140	≥141	*p* for trend	
	SCC		1.7 (0.8–3.5)	1.6 (0.9–2.8)	1.8 (1.0–3.6)	0.003	
	SCLC		1.8 (0.7–4.6)	1.2 (0.6–2.6)	0.8 (0.2–2.3)	0.419	
	Others		2.0 (0.8–5.0)	1.9 (0.9–3.8)	1.8 (0.8–4.3)	0.008	
		Duration (years)	1–10	11–20	≥21	*p* for trend	
	SCC		1.6 (0.7–4.0)	1.7 (1.0–3.1)	2.7 (1.2–6.2)	< 0.001	
	SCLC		2.0 (0.7–5.8)	1.2 (0.5–2.7)	1.6 (0.5–5.3)	0.139	
	Others		2.2 (0.7–6.3)	1.8 (0.8–3.7)	1.7 (0.5–5.7)	0.021	
		Bottle–years	1–34	35–90	≥91	*p* for trend	
	SCC		1.9 (1.0–3.9)	1.7 (0.8–3.9)	1.9 (1.0–3.9)	0.003	
	SCLC		1.7 (0.6–4.5)	1.8 (0.7–4.6)	0.7 (0.2–2.4)	0.298	
	Others		1.6 (0.6–4.3)	2.6 (1.1–6.3)	1.4 (0.5–3.7)	0.025	

Table 2.54 (continued)

Reference	Subject and histology	Exposure categories	Odds ratio (95% CI)			Comments
Carpenter *et al.* (1998)		Intake	1–6 drinks/ week	≥1 drink/day	*p* for trend	Reference, never to 3 drinks/month; adjusted for age, sex, race, saturated fat, pack–years smoked, years since quitting smoking; alcoholic beverage types mutually adjusted
	Men and women					
	AC	*Beer*	0.7 (0.4–1.3)	0.8 (0.4–1.6)	0.35	
	SCC + SCLC		1.0 (0.5–1.8)	0.8 (0.4–1.7)	0.32	
	Other cell types		1.0 (0.5–1.8)	0.6 (0.3–1.3)	0.13	
	AC	*Wine*	1.0 (0.5–1.8)	0.5 (0.2–1.6)	0.22	
	SCC + SCLC		0.6 (0.3–1.1)	0.5 (0.2–1.3)	0.11	
	Other cell types		0.8 (0.4–1.6)	0.8 (0.3–2.0)	0.49	
	AC	*Liquor*	1.0 (0.6–1.9)	1.4 (0.6–3.2)	0.54	
	SCC + SCLC		0.9 (0.5–1.6)	1.8 (0.9–4.0)	0.16	
	Other cell types		1.1 (0.6–1.9)	2.1 (0.9–4.5)	0.20	

Table 2.54 (continued)

Reference	Subject and histology	Exposure categories	Odds ratio (95% CI)						Comments
Zang & Wynder (2001)	'Whiskey–equivalent' (oz alcohol/day)		1–3.9	4–6.9	≥7	Continuous			Reference for current drinking, <1 oz alcohol/day; reference for lifelong exposure, <4 oz/day–year; adjusted for body-mass index, current cigarettes per day; dose–response used oz/day–year as continuous variable.
	Men								
	SCC		1.1 (0.9–1.5)	0.9 (0.7–1.3)	1.4 (1.1–1.8)	1.1 (1.0–1.2)			
	AC		1.1 (0.9–1.4)	1.3 (1.0–1.7)	1.0 (0.8–1.3)	1.0 (0.9–1.1)			
	SCLC		1.2 (0.8–1.7)	1.4 (0.9–2.2)	1.4 (1.0–2.0)	1.1 (1.0–1.3)			
	LCLC		1.2 (0.7–1.8)	0.7 (0.4–1.5)	1.2 (0.7–1.9)	1.0 (0.9–1.2)			
	Lifelong exposure (oz/day 'whiskey–equivalent' × years of drinking)		4–16	17–27	28–64	65–103	≥104	Continuous	
	SCC		1.0 (0.7–1.4)	0.8 (0.5–1.2)	1.1 (0.8–1.6)	1.1 (0.8–1.7)	1.2 (0.9–1.6)	1.0 (1.0–1.1)	
	AC		1.1 (0.8–1.5)	1.6 (1.1–2.3)	1.1 (0.8–1.5)	1.4 (1.0–2.0)	1.1 (0.8–1.5)	1.1 (1.0–1.1)	
	SCLC		1.1 (0.7–1.9)	1.0 (0.5–1.9)	1.0 (0.6–1.7)	1.5 (0.9–2.5)	1.3 (0.9–1.9)	1.0 (1.0–1.1)	
	LCLC		1.1 (0.6–2.0)	1.4 (0.7–2.8)	1.1 (0.6–2.0)	0.9 (0.4–1.8)	[0.9] (0.5–1.5)	1.0 (0.9–1.1)	

Table 2.54 (continued)

Reference	Subject and histology	Exposure categories	Odds ratio (95% CI)				Comments
De Stefani *et al.* (2002)		Ethanol (mL/day)	1–60	61–120	>120	*p* for trend	Reference, non-drinker; adjusted for age, residence, urban/ rural status, education, family history of lung cancer in first-degree relatives, body-mass index, smoking status, cigarettes per day, years since quitting, age at start of smoking
	Men						
	AC		0.8 (0.4–1.5)	1.1 (0.6–2.1)	1.2 (0.6–2.1)	0.34	
		Beer	1.1 (0.5–2.5)	0.6 (0.3–1.6)		0.31	
		Wine	0.6 (0.3–1.2)	0.6 (0.3–1.2)	0.4 (0.2–1.1)	0.29	
		Hard liquor	1.5 (0.8–2.6)	2.9 (1.4–6.2)	1.4 (0.7–3.0)	0.09	
Djoussé *et al.* (2002)	Alcohol (g/day)		0.1–12	12.1–24	>24		Reference, 0 g/ day; adjusted for age, sex, smoking status, pack–years of smoking, year of birth
	Men and women						
	SCC		0.4 (0.1–2.0)	0.4 (0.1–2.6)	0.3 (0.1–1.7)		
	AC		2.9 (0.8–10.9)	1.5 (0.3–8.1)	2.3 (0.5–10.5)		
	Others		0.7 (0.2–2.3)	0.8 (0.2–2.9)	0.8 (0.2–2.7)		

Table 2.54 (continued)

Reference	Subject and histology	Exposure categories	Odds ratio (95% CI)			Comments
Rachtan (2002)	Average vodka intake (g)		<100	≥100	*p* for trend	Reference, non-drinkers; adjusted for age, pack–years of smoking, passive smoking, consumption of milk, butter, margarine, cheese, meat, fruit, vegetables, carrots, spinach, siblings with cancer, tuberculosis, residence, occupational exposure
	Women					
	SCC		1.3 (0.6–2.9)	3.9 (1.0–15.2)	<0.001	
	AC		2.6 (1.2–6.1)	8.0 (1.7–37.7)	0.003	
	SCLC		1.9 (0.8–4.5)	11.8 (3.0–45.9)	<0.001	

Table 2.54 (continued)

Reference	Subject and histology	Exposure categories	Odds ratio (95% CI)		Comments
Benedetti *et al.* (2006)	Drinks/week		1–6	≥7	Reference, never weekly; adjusted for age, respondent status, ethnicity, smoking status, cigarette–years, socioeconomic status, years of schooling, years since quitting
	Men (Study I)				
	SCC		1.3 (0.8–2.2)	1.4 (0.9–2.2)	
	AC		1.8 (0.9–3.5)	2.0 (1.1–3.6)	
	SCLC		1.1 (0.6–2.1)	1.1 (0.6–2.0)	
	LCLC		0.9 (0.4–2.3)	0.5 (0.2–1.3)	
	Men (Study II)				
	SCC		1.3 (0.7–2.2)	1.4 (0.8–2.3)	
	AC		1.0 (0.6–1.7)	1.5 (1.0–2.5)	
	SCLC		1.1 (0.6–2.2)	1.3 (0.7–2.4)	
	LCLC		1.9 (0.7–4.6)	2.0 (0.8–4.9)	
	Women (Study II)				
	SCC		0.2 (0.1–0.4)	1.0 (0.5–2.1)	
	AC		0.5 (0.3–0.8)	0.9 (0.5–1.5)	
	SCLC		0.3 (0.2–0.7)	0.9 (0.4–2.1)	
	LCLC		0.3 (0.1–0.8)	0.4 (0.1–1.2)	

AC, adenocarcinoma; CI, confidence interval; LCLC, large cell lung cancer; SCC, squamous-cell carcinoma; SCLC, small-cell lung cancer

Table 2.55 Cohort studies of beer consumption and lung cancer

Reference	Subjects	Exposure categories	Relative risk (95% CI)	Comments
Pollack *et al.* (1984)	Men	*oz/month*		Adjusted for age, cigarette smoking status (never, former and current smokers), alcohol content of the other two types of beverage (if significant) [values read from graph]
		Non-beer drinker	1.0	
		1–9	[0.7] [0.3–1.5]	
		10–99	[0.5] [0.2–1.4]	
		[100]–499	[1.1] [0.7–2.1]	
		≥500	[1.1] [0.7–2.1]	
Chow *et al.* (1992)	Men	*Times/month*		Adjusted for age, industry/occupation, smoking status (never any tobacco, other tobacco only, occasional/past use of 1–19, 20–29, ≥30 cigarettes/day, current use of 1–19, 20–29, ≥30 cigarettes/day)
		Never drank	1.0	
		<3	1.2 (0.8–1.9)	
		3–5	1.4 (0.8–2.3)	
		6–13	1.7 (1.0–2.9)	
		>13	1.1 (0.6–1.9)	
		Former drinker	1.8 (1.1–3.0)	
Potter *et al.* (1992)	Women	Non-drinker	1.0	Adjusted for smoking (pack–years)
		<1 glass/day	0.6 (0.3–1.2)	
		≥1 glass/day	1.9 (0.96–3.9)	
Woodson *et al.* (1999)	Men	*Ethanol (g/day)*		Adjusted for age, body mass index, years smoked, cigarettes per day, intervention group
		Non-drinker	1.0 (0.9–1.2)	
		Q1 0.01–1.6	1.0 (1.0)	
		Q2 1.7–4.5	0.8 (0.6–1.0)	
		Q3 4.6–11.5	0.9 (0.7–1.1)	
		Q4 11.6–242.6	0.9 (0.7–1.1)	
			p for trend=0.19	
Prescott *et al.* (1999)		*Drinks/week*		Adjusted for age, study cohort, education, smoking (current smoking: pack–years, duration of smoking), other types of alcoholic beverage
	Men	<1	1.0 (1.0)	
		1–13	1.1 (0.8–1.4)	
		>13	1.4 (1.0–1.8)	
	Women	<1	1.0 (1.0)	
		1–13	0.9 (0.6–1.3)	
		>13	1.5 (0.7–3.1)	

Table 2.55 (continued)

Reference	Subjects	Exposure categories	Relative risk (95% CI)	Comments
Freudenheim *et al.* (2005) Pooled analysis of 7 prospective studies		*g/day*		Adjusted for education, body-mass index, energy intake, other types of alcoholic beverage, smoking status (never, past, current), smoking duration for past and current smokers, cigarettes smoked daily for current smokers
	Men	None	1.0	
		>0–<5	0.9 (0.8–1.1)	
		5–<15	0.8 (0.7–1.0)	
		≥15	1.1 (0.9–1.4)	
			p for trend=0.47	
	Women	None	1.0	
		>0–<5	0.8 (0.6–0.9)	
		5–<15	1.2 (1.0–1.5)	
		≥15	1.9 (1.5–2.4)	
			p for trend <0.001	

CI, confidence interval

from beer per day (approximately ≥1 beer per day; odds ratio, 1.9; 95% CI, 1.5–2.4), but the relative risk was 0.8 (95% CI, 0.6–0.9) for those with the lowest level of beer consumption (<5 g ethanol/day). A null association was reported in three studies (Pollack *et al*., 1984; Chow *et al*., 1992; Woodson *et al*., 1999), all of which were restricted to men. Chow *et al*. (1992) reported a relative risk of 1.7 (95% CI, 1.0–2.9) for drinking beer 6–13 times per month, and of 1.1 (95% CI, 0.6–1.9) for drinking beer more than 13 times per month.

Among 11 case–control studies that presented tobacco smoking-adjusted odds ratios for beer drinking compared with non-drinkers, three reported a positive association for the highest level of beer drinking used in the analyses (Bandera *et al*., 1992; De Stefani *et al*., 1993; Benedetti *et al*., 2006, in the first study in men only (Table 2.56).

(b) Wine (Tables 2.57 and 2.58)

Among 10 case–control studies (Table 2.58) that provided tobacco smoking-adjusted risk estimates for wine intake, only one reported a positive association for white wine intake (relative risk, 1.5; 95% CI, 0.5–4.4) but not for red wine or rosé (Ruano-Ravina *et al*., 2004). In contrast, a significant inverse association was observed between red wine consumption and risk for lung cancer in this study. Six other case–control studies reported odds ratios below 1 for wine consumption, although these were not always statistically significant.

Among the three cohort studies that reported risk estimates for wine drinking (Table 2.57), two reported a significant inverse association in men (Prescott *et al*., 1999; Woodson *et al*., 1999 [trend test]). In another study, drinking ≥50 oz of wine per month (approximately ≥10 glasses of wine per month) was associated with a twofold increased risk for lung cancer compared with non-wine drinkers (Pollack *et al*., 1984).

In a pooled analysis based on seven cohort studies (Freudenheim *et al*., 2005), an inverse association was detected by the trend test for men, but not for women.

None of the cohort studies reported relative risk estimates adjusted for dietary factors such as vegetable/fruit intake. Confounding by dietary factors may explain to current observations.

(c) Liquor (Tables 2.59 and 2.60)

Two of five cohort studies reported a positive association between liquor drinking and risk for lung cancer, adjusted for tobacco smoking (Table 2.59) (Pollack *et al*., 1984; Prescott *et al*., 1999 in men only). The strongest association was identified by Pollack *et al*. (1984), in which men who consumed ≥1 measure of whiskey per day were found to have a relative risk of 2.6 [95% CI, 1.3–5.0]. Prescott *et al*. (1999) found a borderline significant 50% increase in risk among men who consumed at least two drinks of liquor per day; no association was observed among women.

Table 2.56 Case–control studies of beer consumption and lung cancer

Reference	Subjects	Exposure categories	Relative risk (95% CI)	Comments
Williams & Horm (1977)	Men	Non-drinker	1.0 (not given)	Adjusted for age, race, smoking; 'controls' were 'tobacco- and alcohol-unrelated' cancer; however, included colon and liver cancer
		<51 can–years	1.2	
		≥51 can–years	1.1	
	Women	Non-drinker	1.0	
		<51 can–years	0.8	
		≥51 can–years	1.1	
Mettlin (1989)	Men and women	*Times/week*		Adjusted for age, residence, sex, smoking history [pack–years or similar index of exposure], β-carotene intake index, education
		Never	1.0	
		<1	0.5 (0.4–0.8)	
		1–3	0.7 (0.5–1.1)	
		4–9	0.7 (0.5–1.2)	
		≥10	1.3 (0.8–2.1)	
Bandera *et al.* (1992)	Men	Drink/month		Adjusted for age, education, smoking (pack–years); no obvious interaction between beer consumption and smoking observed
		0	1.0	
		1–11	1.1 (0.7–1.7)	
		≥12	1.6 (1.0–2.4)	
			p for trend<0.01	
		0	1.0	Also adjusted for carotenoids and fat
		1–11	1.0 (0.7–1.6)	
		≥12	1.5 (1.0–2.2)	
			p for trend=0.009	
De Stefani *et al.* (1993)	Men	*Ethanol (mL/day)*		Adjusted for age, residence, education, smoking (pack–years), other types of alcoholic beverage
		Lifetime abstainers	1.0	
		1–9	0.7 (0.3–2.5)	
		10–59	1.4 (0.4–6.2)	
		>59	3.4 (1.3–15.2)	
			p for trend=0.02	

Table 2.56 (continued)

Reference	Subjects	Exposure categories	Relative risk (95% CI)	Comments
Mayne *et al.* (1994)	Men and Women	*Monthly frequency* Q1 Q2 Q3 Q4	(not given) 1.0 (ref) 1.1 0.9 1.2 *p* for trend=NS	*p* value >0.05 for odds ratios of quartiles 2–4; adjusted for age, sex, county of residence, smoking history (never and former), cigarettes/day smoked in former smokers, religion, education, body mass index, income; ranges for quartiles not provided
Rachtan & Sokolowski (1997)	Women	Non-drinker Rarely 1–2/month At least once/week	1.0 1.1 (0.5–2.3) 1.8 (0.5–6.7) 3.3 (0.6–17.5) *p* for trend=0.126	Estimates only adjusted for age, not for smoking; updated analysis given in Rachtan (2002)
Carpenter *et al.* (1998)	Men and women	*Recent consumption* Never to 3 drinks/mth 1–6 drinks/week ≥1 drink/day *p* for trend=0.45 *Consumption between age 30 and 40 years* Never to 3 drinks/mth 1–6 drinks/week ≥1 drink/day *p* for trend=0.09	 1.0 0.4 (0.2–0.7) 0.9 (0.4–1.8) 1.0 0.9 (0.6–1.4) 0.7 (0.4–1.2)	Adjusted for age, gender, race, saturated fat consumption, tobacco smoking (pack–years), years since quitting tobacco smoking, other types of alcoholic beverage
De Stefani *et al.* (2002)	Men	*Ethanol (mL/day)* Non-drinker 1–60 >60 *p* for trend=0.31 Abstainer Beer only	 1.0 1.1 (0.5–2.5) 0.6 (0.3–1.6) 1.0 0.9 (0.1–5.6)	Adenocarcinoma only; adjusted for age, residence, urban/rural status, education, family history of lung cancer in first-degree relatives, body mass index, smoking status, cigarettes per day, years since quitting, age at start of smoking, other types of alcoholic beverage; [for exclusive consumption of a specific alcoholic beverage, total alcohol intake might also be adjusted for].

Table 2.56 (continued)

Reference	Subjects	Exposure categories	Relative risk (95% CI)	Comments
Hu *et al*.(2002)	Women	*Servings/week*		Never smokers only; adjusted for age, province, education, social class
		0	1.0	
		≤0.5	1.2 (0.6–2.4)	
		>0.5	0.5 (0.2–1.1)	
			p for trend=0.17	
Rachtan (2002)	Women	*Frequency*		Adjusted for age only; estimates not adjusted for smoking [Unit of time not given]
		Non-drinker	1.0	
		Rarely	1.0 (0.6–1.8)	
		≥3 times/month	2.6 (1.5–4.5)	
			p for trend=0.002	
		Average amount (g)		
		Non-drinker	1.0	
		≥250	1.3 (0.8–2.0)	
		>250	9.0 (2.6–31.6)	
			p for trend<0.001	
		Drinking duration (years)		
		Non-drinker	1.0	
		≤29	1.0 (0.5–1.9)	
		≥30	2.0 (1.3–3.3)	
			p for trend=0.005	

Table 2.56 (continued)

Reference	Subjects	Exposure categories	Relative risk (95% CI)	Comments
Freudenheim *et al.* (2003)	Men and women	*Lifetime consumption* (L) 0 ≤62 >62 *Consumption in previous 12–24 months* (L) 0 ≤1.6 >1.6	 1.0 1.2 (0.7–1.9) 1.4 (0.8–2.3) *p* for trend=0.30 1.0 0.8 (0.4–1.4) 1.7 (1.0–2.9) *p* for trend=0.05	Adjusted for age, education, race, sex, body mass index, vegetable intake, fruit intake, total energy intake excluding alcohol, packs smoked per year, years smoked, index of passive exposure to smoke at home, work, in other settings
Ruano-Ravina *et al.* (2004)	Men and women	Non-drinker Drinker *Continuous variable* Beer (weekly unit)	1.0 (0.6–2.1) 1.1 (0.97–1.02) 0.99	Adjusted for age, sex, occupation, smoking habit (total lifetime tobacco consumption in thousands of packs), total alcoholic beverage intake
Benedetti *et al.* (2006)	Men (Study I) Men (Study II) Women (Study II)	Never weekly 1–6 drinks/week ≥7 drinks/week Never weekly 1–6 drinks/week ≥7 drinks/week Never weekly 1–6 drinks/week ≥7 drinks/week	1.0 1.2 (0.9–1.7) 1.5 (1.1–2.1) 1.0 1.0 (0.7–1.4) 1.0 (0.7–1.4) 1.0 0.3 (0.2–0.5) 0.9 (0.5–1.6)	Adjusted for age, smoking status, cigarette–years, time since quitting, respondent status, ethnicity, census tract income, years of schooling

CI, confidence interval; NS, not significant

Table 2.57 Cohort studies of wine consumption and lung cancer

Reference	Subjects	Exposure categories	Relative risk (95% CI)	Comments
Pollack *et al.* (1984)		*oz/month*		Adjusted for age, cigarette-smoking status (never, former, current smokers), alcohol content of the other two types of beverage (if significant) [read from graph]
		Non-wine drinker	1.0	
	8006 Men	1	[1.2] [0.6–2.6]	
		2–49	[0.8] [0.2–2.6]	
		≥50	2.2 [1.0–4.4]	
Prescott *et al.* (1999)		*Drinks/week*		Adjusted for age, study cohort, education, smoking (current smoking: pack–years, duration of smoking), other types of alcoholic beverage
	17 669 Men	<1	1.0	
		1–13	0.8 (0.6–1.0)	
		>13	0.4 (0.2–0.9)	
	13 525 Women	<1	1.0	
		1–13	0.9 (0.6–1.3)	
		>13	0.2 (0.0–1.3)	
Woodson *et al.* (1999)		*Ethanol (g/day)*		Adjusted for age, body mass index, years smoked, cigarettes per day, intervention group
	27 111 Men	Non-drinker	1.1 (0.9–1.3)	
		0.09–2.0	1.0	
		2.1–67.5	0.8 (0.6–1.1)	
			p for trend=0.02	
Freudenheim *et al.* (2005) Pooled analysis of 7 prospective studies		*g/day*		Adjusted for education, body mass index, energy intake, other types of alcoholic beverage, smoking status (never, past, current), smoking duration for past and current smokers, cigarettes smoked daily for current smokers
	Men	None	1.0	
		>0–<5	0.9 (0.8–1.1)	
		5–<15	0.7 (0.5–0.9)	
		≥15	0.9 (0.6–1.4)	
			p for trend=0.04	
	Women	None	1.0	
		>0–<5	0.9 (0.7–1.1)	
		5–<15	0.8 (0.5–1.1)	
		≥15	1.1 (0.8–1.5)	
			p for trend=0.99	

CI, confidence interval

Table 2.58 Case–control studies of wine consumption and lung cancer

Reference	Subjects	Exposure categories	Relative risk (95% CI)	Comments
Williams & Horm (1977)	Men	Non-drinker	1.0 (not given)	Adjusted for age, race, smoking; 'controls' had 'tobacco- and alcohol-unrelated' cancer; however, controls included colon and liver cancer.
		<51 glass–years	0.6	
		≥51 glass–years	1.1	
	Women	Non-drinker	1.0	
		<51 glass–years	0.7	
		≥51 glass–years	1.1	
Mettlin (1989)	Men and women	*Times/week*		Adjusted for age, residence, sex, smoking history [pack–years or similar index of exposure], β-carotene intake index, education
		Never	1.0	
		<1	0.6 (0.4–0.8)	
		1–3	0.5 (0.3–0.8)	
		4–9	0.8 (0.5–1.5)	
		≥10	1.0 (0.4–2.5)	
Bandera *et al.* (1992)	Men	*Drinks/month*		Adjusted for age, education, smoking (pack–years); no obvious interaction between wine consumption and smoking observed
		0	1.0	
		1	1.0 (0.7–1.4)	
		≥2	0.7 (0.5–1.1)	
			p for trend=0.4	
De Stefani *et al.* (1993)	Men	*Ethanol (mL/day)*		Adjusted for age, residence, education, smoking (pack–years), other types of alcoholic beverage
		Lifetime abstainer	1.0	
		1–36	1.2 (0.7–2.2)	
		37–120	1.3 (0.7–3.1)	
		>120	1.5 (0.9–3.3)	
			p for trend=0.09	
Rachtan & Sokolowski (1997)	Women	Non-drinker	1.0	Estimates only adjusted for age, not for smoking; updated analysis given in Rachtan (2002)
		Rarely	0.9 (0.5–1.8)	
		1–2/month	1.1 (0.5–2.5)	
		At least 1/week	1.2 (0.2–8.5)	
			p for trend=0.958	

Table 2.58 (continued)

Reference	Subjects	Exposure categories	Relative risk (95% CI)	Comments
Carpenter *et al.* (1998)	Men and women	*Recent consumption*		Adjusted for age, gender, race, saturated fat consumption, tobacco smoking (pack–years), years since quitting tobacco smoking, other types of alcoholic beverage
		Never to 3 drinks/month	1.0	
		1–6 drinks/week	0.7 (0.4–1.3)	
		≥1 drink/day	0.8 (0.3–1.9)	
			p for trend=0.66	
		Consumption between age 30 and 40 years		
		Never to 3 drinks/month	1.0	
		1–6 drinks/week	0.8 (0.5–1.3)	
		≥1 drink/day	0.6 (0.3–1.3)	
			p for trend=0.16	
De Stefani *et al.* (2002)	Men	*Alcohol (mL/day)*		Adenocarcinoma only; adjusted for age, residence, urban/rural status, education, family history of lung cancer in first-degree relatives, body mass index, smoking status, cigarettes per day, years since quitting, age at start of smoking, other types of alcoholic beverage; [for exclusive consumption of a specific alcoholic beverages, total alcohol intake might also be adjusted for].
		Non-drinker	1.0	
		1–60	0.6 (0.3–1.2)	
		61–120	0.6 (0.3–1.2)	
		>120	0.4 (0.2–1.1)	
			p for trend=0.09	
		Abstainer	1.0	
		Wine only	0.7 (0.4–1.4)	
Hu *et al.* (2002)	Women	*Servings/week*		Never smokers only; adjusted for age, province, education, social class
		0	1.0	
		≤0.5	0.7 (0.4–1.2)	
		>0.5	0.7 (0.4–1.2)	
			p for trend=0.10	

Table 2.58 (continued)

Reference	Subjects	Exposure categories	Relative risk (95% CI)	Comments
Rachtan (2002)	Women	*Frequency*		Adjusted for age only; estimates not adjusted for smoking [Unit of time not given]
		Non-drinker	1.0	
		Rarely	1.3 (0.9–1.9)	
		≥3 times/month	2.0 (1.2–3.3)	
			p for trend=0.007	
		Average amount (g)		
		Non-drinker	1.0	
		≤70	1.1 (0.8–1.7)	
		>70	2.6 (1.6–4.4)	
			p for trend=0.001	
		Drinking duration (years)		
		Non-drinker	1.0	
		≤29	1.4 (0.8–2.4)	
		≥30	1.6 (1.1–2.3)	
			p for trend=0.021	
Freudenheim *et al.* (2003)	Men and women	*Lifetime consumption* (L)		Adjusted for age, education, race, sex, body mass index, vegetable intake, fruit intake, total energy intake excluding alcohol, packs smoked per year, years smoked, index of passive smoking exposure to smoke at home, work, in other settings
		0	1.0	
		≤19	0.9 (0.5–1.4)	
		>19	0.8 (0.5–1.3)	
			p for trend=0.06	
		Consumption in previous 12–24 months (L)		
		0	1.0	
		≤1.0	0.7 (0.4–1.3)	
		>1.0	0.7 (0.4–1.3)	
			p for trend=0.10	

Table 2.58 (continued)

Reference	Subjects	Exposure categories	Relative risk (95% CI)	Comments
Ruano-Ravina *et al.* (2004)	Men and women	Non-drinker	1.0	Adjusted for age, sex, occupation, smoking habit (total lifetime tobacco consumption in thousands of packs), total alcohol intake
		White	1.5 (0.5–4.4)	
		Red	0.4 (0.2–1.0)	
		Rosé	0.4 (0.1–1.4)	
		All types	0.5 (0.2–1.4)	
		Continuous variable		
		Red (glasses/day)	0.9 (0.8–1.0)	
		White (glasses/day)	1.2 (1.0–1.4)	
		Rosé (glasses/day)	1.0 (0.8–1.1)	
Benedetti *et al.* (2006)	Men (Study I)	Never weekly	1.0	Adjusted for age, smoking status, cigarette–years, time since quitting, respondent status, ethnicity, census tract income, years of schooling
		1–6 drinks/week	1.4 (1.0–1.9)	
		≥7 drinks/week	0.7 (0.4–1.1)	
	Men (Study II)	Never weekly	1.0	
		1–6 drinks/week	0.6 (0.4–0.8)	
		≥7 drinks/week	0.8 (0.5–1.1)	
	Women (Study II)	Never weekly	1.0	
		1–6 drinks/week	0.3 (0.2–0.4)	
		≥7 drinks/week	0.7 (0.4–1.2)	

CI, confidence interval

In a pooled analysis (Freudenheim *et al*., 2005), a positive association was detected among men who drank one measure of liquor per day or more, with a significant dose–response relationship. No association was observed among women.

Liquor consumption was found to be positively associated with the risk for lung cancer in three (Carpenter *et al*., 1998; De Stefani *et al*., 2002; Rachtan, 2002) of 11 case–control studies that reported tobacco smoking-adjusted odds ratio estimates for liquor consumption (Table 2.60). The strongest association was found in the study by Rachtan (2002), in which Polish women who consumed ≥100 g alcohol from liquor per week (approximately one measure per day) had an eightfold greater risk for lung cancer than non-drinking women (95% CI, 2.9–21.2).

2.10.4 *Studies stratified by tobacco-smoking status (Tables 2.61 and 2.62)*

Studies based on never smokers may be the most valid approach to study the carcinogenicity of alcoholic beverages in the lung. In smokers, tobacco smoking may modify the effect of alcohol consumption and heterogeneity of risk may exist between populations with different smoking patterns. One of the proposed mechanisms for the carcinogenic effect of alcoholic beverages is that they may act as a solvent for tobacco-associated carcinogens. It is therefore important to examine the effect of alcoholic beverage consumption among both never smokers and smokers, and to study the interaction between these two risk factors. Tables 2.61 and 2.62 summarize the results from cohort and case–control studies that presented relative risks for alcoholic beverage use by smoking category.

Results from two cohort studies (Nishino *et al*., 2006; Rohrmann *et al*., 2006) did not seem to suggest an interaction between smoking status (never, former and current) and alcoholic beverage consumption, although a *p*-value for a formal test of interaction was not available. [These analyses may have the limitation that most of the cases of lung cancer were smokers.]

In a pooled analysis (Freudenheim *et al*., 2005), no obvious interaction was suggested following stratification by smoking status among women. A positive association was only found among male never smokers but not among male former or current smokers, which suggests a heterogeneity of the effect of alcoholic beverages by smoking status in men.

Since most cases of lung cancer are smokers, several cohort and case–control studies examined the effect of alcoholic beverages according to the amount smoked. Woodson *et al*. (1999) conducted a cohort study with detailed analyses of the effect of alcoholic beverage according to intake by smoking behaviour, characterized by the number of cigarettes per day, duration of smoking, frequency of inhaling and time since quitting. No obvious differences in the relative risks were found across these smoking categories. Most of the case–control studies reported significant positive associations only among smokers or greater risk estimates among heavier smokers than among lighter smokers (Herity *et al*., 1982; De Stefani *et al*., 1993; Dosemeci *et al*., 1997; Zang & Wynder, 2001; Benedetti *et al*., 2006 [men only]).

Table 2.59 Cohort studies of liquor consumption and lung cancer

Reference	Subjects	Exposure categories	Relative risk (95% CI)	Comments
Pollack *et al.* (1984)	Men	*oz/month*		Adjusted for age, cigarette-smoking status (never, former, current smokers), alcohol content of the other two types of beverage (if significant); [read from graph]
		Non-whiskey drinker	1.0	
		1–4	[1.1] [0.6–2.0]	
		5–49	[1.0] [0.5–2.1]	
		≥50	2.6 [1.3–5.0]	
Chow *et al.* (1992)	Men	*Times/month*		Adjusted for age, industry/occupation, smoking status (never any tobacco, other tobacco only, occasional/past use of 1–19, 20–29, ≥30 cigarettes/day, current use of 1–19, 20–29, ≥30 cigarettes/day)
		Never drank	1.0	
		<3	1.3 (0.9–2.0)	
		3–5	1.3 (0.8–2.1)	
		6–13	1.3 (0.7–2.2)	
		>13	1.0 (0.5–1.8)	
		Former drinker	1.9 (1.1–3.1)	
Potter *et al.* (1992)	Women	Non-drinker	1.0	Adjusted for smoking (pack–years)
		≥1/day	1.1 (0.6–2.3)	
Woodson *et al.* (1999)	Men	*Ethanol (g/day)*		Adjusted for age, body mass index, years smoked, cigarettes per day, intervention group
		Non-drinker	1.1 (0.9–1.3)	
		Q1 0.01–2.6	1.0	
		Q2 2.7–10.6	1.0 (0.9–1.3)	
		Q3 10.7–22.7	1.1 (0.9–1.3)	
		Q4 22.8–160.0	1.1 (0.9–1.3)	
			p for trend=0.12	
Prescott *et al.* (1999)		*Drinks/week*		Adjusted for age, study cohort, education, smoking (current smoking: pack–years, duration of smoking), other types of alcoholic beverage
	Men	<1	1.0	
		1–13	1.2 (0.97–1.5)	
		>13	1.5 (0.99–2.1)	
	Women	<1	1.0	
		1–13	0.8 (0.6–1.2)	
		>13	0.7 (0.2–2.2)	

Table 2.59 (continued)

Reference	Subjects	Exposure categories	Relative risk (95% CI)	Comments
Freudenheim *et al*. (2005) Pooled analysis of 7 prospective studies		*g/day*		Adjusted for education, body mass index, energy intake, other types of alcoholic beverage, smoking status (never, past, current), smoking duration for past and current smokers, cigarettes smoked daily for current smokers
	Men	None	1.0	
		>0–<5	1.2 (0.98–1.4)	
		5–<15	1.0 (0.8–1.2)	
		≥15	1.3 (1.1–1.7)	
			p for trend=0.04	
	Women	None	1.0	
		>0–<5	0.9 (0.7–1.0)	
		5–<15	0.8 (0.6–1.1)	
		≥15	1.0 (0.8–1.2)	
			p for trend=0.52	

CI, confidence interval

Table 2.60 Case–control studies of liquor consumption and lung cancer

Reference	Subjects	Exposure categories	Relative risk (95% CI)	Comments
Williams & Horm (1977)	Men	Non-drinker	1.0 (not given)	Adjusted for age, race, smoking; controls included colon and liver cancer
		<51 jigger–years	0.9	
		≥51 jigger–years	1.1	
	Women	Non-drinker	1.0	
		<51 jigger–years	1.2	
		≥51 jigger–years	0.6	
Mettlin (1989)	Men and women	*Times/week*		Adjusted for age, residence, sex, smoking history [pack–years or similar index of exposure], β-carotene intake index, education
		Never	1.0	
		<1	0.7 (0.5–1.0)	
		1–3	0.9 (0.6–1.5)	
		4–9	0.6 (0.4–0.9)	
		≥10	0.7 (0.4–1.1)	
Bandera *et al.* (1992)	Men	*Drinks/month*		Adjusted for age, education, smoking (pack–years); no obvious interaction between liquor consumption and smoking was observed.
		0	1.0	
		1–8	0.6 (0.4–1.0)	
		≥9	1.1 (0.7–1.6)	
			p for trend=0.1	
De Stefani *et al.* (1993)	Men	*Ethanol (mL/day)*		Adjusted for age, residence, education, smoking (pack–years), other types of alcoholic beverage
		Lifetime abstainer	1.0	
		1–34	0.9 (0.6–1.6)	
		35–115	1.3 (0.8–2.6)	
		>115	1.1 (0.6–1.4)	
			p for trend=0.50	
Rachtan & Sokolowski (1997)	Women	*Vodka*		Adjusted for pack–years smoked, carrot intake, margarine on bread
		Non-drinker	1.0	
		1–2/month	2.6 (1.3–5.5)	
		At least 1/week	7.5 (0.8–71.0)	

Table 2.60 (continued)

Reference	Subjects	Exposure categories	Relative risk (95% CI)	Comments
Carpenter *et al.* (1998)	Men and women	*Recent consumption*		Adjusted for age, gender, race, saturated fat consumption, tobacco smoking (pack–years), years since quitting tobacco smoking, other types of alcoholic beverage
		Never to 3 drinks/month	1.0	
		1–6 drinks/week	1.2 (0.7–2.2)	
		≥1 drink/day	1.9 (1.0–3.4)	
			p for trend=0.06	
		Consumption between age 30 and 40 years		
		Never to 3 drinks/month	1.0 (0.7–1.5)	
		1–6 drinks/week	1.0 (1.1–3.2)	
		≥1 drink/day	1.8	
			p for trend=0.06	
De Stefani *et al.* (2002)	Men	*Ethanol (ml/day)*		Adenocarcinoma only; adjusted for age, residence, urban/rural status, education, family history of lung cancer in first-degree relatives, body mass index, smoking status, cigarettes per day, years since quit, age at start of smoking, other types of alcoholic beverage; [for exclusive consumption of a specific alcoholic beverage, total alcohol intake might also be adjusted for].
		Non-drinker	1.0	
		1–60	1.5 (0.8–2.6)	
		61–120	2.9 (1.4–6.2)	
		>120	1.4 (0.7–3.0)	
			p for trend=0.09	
		Abstainer	1.0	
		Liquor only	2.1 (0.9–4.9)	
Hu *et al.* (2002)	Women	*Servings/week*		Never smokers only; adjusted for age, province, education, social class
		0	1.0	
		≤0.5	1.1 (0.6–2.1)	
		>0.5	1.1 (0.6–2.1)	
			p for trend=0.58	
Rachtan (2002)	Women	*Average amount (g)*		Adjusted for age, pack–years of smoking, passive smoking, siblings with cancer, tuberculosis, place of residence, occupational exposure, dietary factors [unit of time not given]
		Non-drinker	1.0	
		<100	2.2 (1.3–3.8)	
		≥100	7.8 (2.9–21.2)	
			p for trend<0.0001	

Table 2.60 (continued)

Reference	Subjects	Exposure categories	Relative risk (95% CI)	Comments
Freudenheim *et al.* (2003)	Men and women	*Lifetime consumption (L)*		Adjusted for age, education, race, sex, body mass index, vegetable intake, fruit intake, total energy intake excluding alcohol, packs smoked per year, years smoked, index of passive smoking exposure to smoke at home, work, in other settings
		0	1.0	
		≤28	1.2 (0.8–1.9)	
		>28	0.8 (0.5–1.2)	
			p for trend=0.44	
		Consumption in previous 12–24 months (L)		
		0	1.0	
		≤1.0	0.6 (0.3–1.2)	
		>1.0	0.9 (0.5–1.5)	
			p for trend=0.47	
Ruano-Ravina *et al.* (2004)	Men and women	Non-drinker	1.0	Adjusted for age, sex, occupation, smoking habit (total lifetime tobacco consumption in thousands of packs), total alcoholic beverage intake
		Drinker	1.6 (0.8–3.4)	
		Continuous variable		
		Liquor (weekly unit)	1.0 (1.0–1.1)	
Benedetti *et al.* (2006)	Men (Study I)	Never weekly	1.0	Adjusted for age, smoking status, cigarette–years, time since quitting, respondent status, ethnicity, census tract income, years of schooling
		1–6 drinks/week	1.4 (1.0–1.9)	
		≥7 drinks/week	1.2 (0.8–1.7)	
	Men (Study II)	Never weekly	1.0	
		1–6 drinks/week	0.9 (0.7–1.2)	
		≥7 drinks/week	0.9 (0.7–1.3)	
	Women (Study II)	Never weekly	1.0	
		1–6 drinks/week	0.4 (0.3–0.6)	
		≥7 drinks/week	1.7 (0.8–3.5)	

CI, confidence interval

Table 2.61 Cohort studies of alcoholic beverage consumption and lung cancer stratified by smoking status

Reference	Subjects and smoking status	Exposure categories	Risk ratio (95% CI)					Comments
Murata *et al.* (1996)	Ethanol (ml/day)		>0 and ≤27	>27				Reference, 0 mL/day; crude CI from data matched on age
	Men							
	Never smokers + former smokers		1.3 [(0.5–3.2)]	2.2 [(0.8–6.1)]				
	Current smokers		0.7 [(0.3–1.6)]	1.5 [(0.7–3.0)]				
Woodson *et al.* (1999)	Alcohol (g/day)		Non-drinker	5.3–13.3	13.4–27.6	≥27.7	*p* for trend	Reference, 0–5.2 g/day; all smokers; smokers defined as men who smoked 5 or more cigarettes per day; cut-offs for alcohol based on quartiles; adjusted for age, body mass index, years smoked, cigarettes per day, treatment group
	Men							
	Cigarettes/ day							
	<20		1.2 (0.8–1.7)	0.9 (0.7–1.3)	0.9 (0.6–1.3)	1.2 (0.8–1.7)	0.59	
	20–29		1.2 (0.9–1.6)	1.1 (0.8–1.4)	1.0 (0.7–1.3)	1.0 (0.8–1.4)	0.99	
	≥30		1.0 (0.6–1.6)	0.9 (0.6–1.3)	0.8 (0.5–1.2)	0.8 (0.5–1.2)	0.26	
	Years smoked							
	<32		1.4 (0.7–2.9)	1.1 (0.6–2.1)	1.1 (0.6–2.1)	1.0 (0.5–1.9)	0.87	
	32–40		1.4 (1.0–2.0)	1.1 (0.8–1.5)	1.1 (0.8–1.5)	1.3 (0.9–1.7)	0.16	
	>40		1.0 (0.8–1.3)	0.9 (0.7–1.2)	0.8 (0.6–1.0)	0.9 (0.7–1.1)	0.13	
	Inhaled							
	Seldom		1.4 (0.7–2.8)	0.8 (0.4–1.7)	0.7 (0.3–1.5)	0.7 (0.3–1.7)	0.37	
	Often		1.4 (1.0–2.0)	1.2 (0.9–1.5)	1.1 (0.8–1.5)	1.1 (0.8–1.5)	0.81	
	Always		1.0 (1.0–1.3)	0.9 (0.7–1.1)	0.8 (0.7–1.1)	1.0 (0.8–1.2)	0.84	
	Cessation							
	<3 years		1.2 (0.7–2.0)	0.8 (0.5–1.4)	1.1 (0.6–2.0)	0.9 (0.5–1.8)	0.67	
	>3 years		1.2 (0.6–2.6)	0.9 (0.4–1.8)	0.8 (0.4–1.7)	1.5 (0.7–3.2)	0.81	
	Never		1.2 (0.9–1.5)	1.0 (0.8–1.2)	0.9 (0.7–1.1)	1.0 (0.8–1.2)	0.16	

Table 2.61 (continued)

Reference	Subjects and smoking status	Exposure categories	Risk ratio (95% CI)				Comments
Freudenheim *et al.* (2005)	Alcohol (g/day)		>0–<5	5–<15	≥15	*p* for trend	Reference, 0 g/day; adjusted for education, body mass index, energy intake; for former smokers, also adjusted for smoking duration; for current smokers, also adjusted for smoking duration and cigs/day
	Men						
	Nonsmoker		1.5 (0.6–3.5)	2.5 (1.1–5.8)	6.4 (2.7–14.9)	<0.01	
	Former smoker		0.7 (0.5–1.0)	0.9 (0.7–1.2)	0.9 (0.7–1.3)	0.27	
	Current smoker		0.9 (0.5–1.4)	1.0 (0.8–1.4)	0.9 (0.7–1.2)	0.92	
	Current smoker (<20 cigs/day)		0.8 (0.4–1.7)	1.0 (0.7–1.5)	0.8 (0.5–1.1)	0.12	
	Women						
	Nonsmoker		1.0 (0.7–1.4)	0.9 (0.5–1.5)	1.4 (0.6–2.9)	0.98	
	Former smoker		0.7 (0.4–1.2)	0.9 (0.6–1.2)	1.1 (0.7–1.8)	0.26	
	Current smoker		0.8 (0.6–1.0)	0.9 (0.7–1.1)	1.1 (0.9–1.3)	0.02	
	Current smoker (<20 cigs/day)		0.6 (0.4–0.9)	0.8 (0.6–1.1)	0.9 (0.7–1.3)	0.42	

Table 2.61 (continued)

Reference	Subjects and smoking status	Exposure categories	Risk ratio (95% CI)						Comments
Nishino *et al*. (2006)	Ethanol (g/day)		Ever drinker	≤24.9	25.0–49.9	≥50	*p* for trend	Former drinker	Reference, never drinker; adjusted for age, family history of lung cancer, intake of green leafy vegetables, oranges, other fruits
	Men								
	Never smoker		1.2 (0.4–3.5)	1.1 (0.4–3.5)	0.4 (0.0–3.2)	1.2 (0.1–10.0)	0.61	4.2 (1.1–15.7)	
	Former smoker		0.7 (0.4–1.3)	0.6 (0.4–1.2)	0.7 (0.3–1.3)	0.3 (0.1–1.5)	0.13	1.4 (0.7–2.6)	
	Current smoker								
	≤20 cigs/day		0.9 (0.6–1.3)	0.8 (0.5–1.2)	0.8 (0.5–1.3)	1.1 (0.6–2.0)	0.99	1.3 (0.7–2.4)	
	>20 cigs/day		1.3 (0.7–2.5)	0.7 (0.3–1.7)	1.5 (0.7–3.0)	1.3 (0.6–2.9)	0.20	2.6 (1.1–6.1)	

Table 2.61 (continued)

Reference	Subjects and smoking status	Exposure categories	Risk ratio (95% CI)						Comments
Rohrmann *et al.* (2006)	Ethanol (g/day)		Non-drinker	5–14.9	15–29.9	30–59.9	≥60	*p* interaction	Reference, 0.1–4.9 g/day; all results stratified by age, sex, study centre; adjusted for height, weight, consumption of fruit, red meat, processed meat, education, total non-ethanol energy intake; for former smokers, also adjusted for smoking duration, time since quitting; for current smokers, also adjusted for smoking duration, cigs/day
	Men and women								
		Baseline intake							
	Never smoker		0.6 (0.3–1.2)	0.9 (0.6–1.5)	0.7 (0.3–1.4)	0.6 (0.2–1.8)			
	Former smoker		1.5 (1.0–2.2)	0.7 (0.5–1.0)	0.7 (0.5–1.0)	0.9 (0.6–1.3)	0.9 (0.5–1.7)	0.64	
	Current smoker		1.3 (1.0–1.7)	0.8 (0.6–1.0)	0.9 (0.7–1.2)	1.0 (0.8–1.3)	0.9 (0.7–1.2)		
		Mean lifelong intake							
	Never smoker		0.5 (0.2–1.2)	0.5 (0.3–0.8)	0.6 (0.3–1.5)	0.4 (0.1–3.0)	1.2 (0.1–13.6)		
	Former smoker		1.9 (0.9–4.2)	1.1 (0.8–1.6)	1.3 (0.9–2.0)	1.3 (0.8–2.2)	1.7 (0.9–3.5)	0.22	
	Current smoker		1.0 (0.6–1.8)	0.8 (0.6–1.0)	0.9 (0.7–1.2)	0.8 (0.6–1.1)	1.2 (0.8–1.7)		

CI, confidence interval

Table 2.62 Case–control studies of alcoholic beverage consumption and lung cancer stratified by smoking status

Reference	Subjects	Smoking status	Exposure categories	Odds ratio (95% CI)			Comments
Herity *et al.* (1982)			Intake (g/day for 10 years)	0–<90	≥90		[Assuming 20 cigarettes/pack]
	Men	0–<43 pack–years		1.0	1.5 (0.4–5.2)		
		≥43 pack–years		10.6 (4.6–24.1)	12.4 (5.4–28.4)		
Bandera *et al.* (1992)			Drinks/month	≥ 21	*p* for trend		Reference, 0–20 drinks/month; adjusted for age, smoking, education; no obvious interaction between beer, wine or liquor consumption and smoking observed
	Men	0–40 pack–years		0.9 (0.6–1.6)	0.10		
		>40 pack–years		1.6 (1.0–2.5)	0.03		
De Stefani *et al.* (1993)			Beer (mL/day)	1–9	10–59	≥60	Reference, non-drinkers; adjusted for age, residence
	Men	0–19 cigs/day		0.4 (0.1–2.2)	–	2.9 (0.5–15.7)	
		≥20 cigs/day		0.9 (0.4–2.0)	2.4 (0.6–8.9)	4.2 (1.4–12.6)	

Table 2.62 (continued)

Reference	Subjects	Smoking status	Exposure categories	Odds ratio (95% CI)				Comments
Dosemeci *et al.* (1997)			Duration (years)	Never drank	1–20	≥21		Reference, never smoker and never drinker
	Men	Never smoker		1.0	–	–		
		1–20 cigs/day		2.8 (2.1–3.6)	4.4 (2.6–7.3)	5.2 (2.0–14.6)		
		≥21 cigs/day		6.1 (4.0–9.3)	8.5 (2.5–14.3)	14.1 (3.9–61.2)		
Zang & Wynder (2001)			'Whiskey-equivalent' oz/day	0	1–5.9	≥6		Reference, non-drinkers and nonsmokers; data for current smokers only also reported
	Men	Nonsmoker		1.0	1.2 (0.7–2.1)	0.7 (0.2–2.0)		
		<20 cigs/day		6.2 (3.5–11.0)	7.4 (4.8–11.5)	8.3 (5.3–13.1)		
		20 cigs/day		13.8 (8.2–21.5)	14.6 (10.0–21.5)	15.4 (10.4–22.8)		
		>20 cigs/day		26.3 (18.0–38.6)	25.9 (18.4–36.4)	26 (18.6–36.5)		
Rachtan (2002)			Alcohol (g/week)	≥1–4	≥4–8	≥1–8	>8	Reference, <1 g/week; nonsmokers were never smokers
	Women	Nonsmoker		3.9 (1.8–8.3)	8.8 (2.8–27.3)		12.1 (3.9–36.9)	
		Current smoker				2.5 (1.2–5.1)	3.7 (1.7–8.2)	
		Current + former smoker				2.8 (1.5–5.1)	5.0 (2.5–9.9)	
			Vodka drinking	Non-drinker	Drinker			Reference, nonsmoker/non-drinker
		Nonsmoker		1.0	3.5 (1.9-6.4)			
		Smoker		10.5 (5.8-19.2)	20.2 (11.7-35.0)			

Table 2.62 (continued)

Reference	Subjects	Smoking status	Exposure categories	Odds ratio (95% CI)		Comments
Benedetti *et al.* (2006)		Cigarette–years	Drinks/week	1–6	≥7	Reference, never weekly; adjusted for age, respondent status, ethnicity, smoking status, cigarette–years, socioeconomic status, years of schooling, time since quitting. *Odds ratio for women consuming 1 or more beer weekly compared with women who never consumed beer on a weekly basis
			Total alcohol			
	Study I	<825		1.0 (0.5–1.8)	1.3 (0.7–2.4)	
	Men	825–1375		1.1 (0.6–2.0)	1.1 (0.6–2.0)	
		>1375		1.8 (0.8–4.3)	1.5 (0.8–3.1)	
			p for interaction	0.26	0.52	
	Study II	<675		0.3 (0.1-0.6)	0.7 (0.4–1.2)	
	Men	675–1270		1.4 (0.8–2.6)	1.9 (1.1–3.4)	
		>1270		1.9 (1.0–3.7)	1.6 (0.9–2.8)	
			p for interaction	0.00	0.06	
	Women	0		0.2 (0.0–0.6)	1.1 (0.4–3.3)	
		≤861		0.6 (0.3–1.1)	0.9 (0.5–1.8)	
		>861		0.2 (0.1–0.4)	0.5 (0.2–1.0)	
			p for interaction	0.70	0.54	
			Beer			
	Study I	<825		0.9 (0.5–1.6)	1.3 (0.7–2.3)	
	Men	825–1375		1.4 (0.8–2.5)	1.8 (1.0–3.0)	
		>1375		1.4 (0.7–3.0)	1.4 (0.7–2.6)	
			p for interaction	0.15	0.35	
	Study II	<675		0.6 (0.3–1.2)	0.9 (0.5–1.8)	
	Men	675–1270		1.1 (0.7–1.8)	1.4 (0.8–2.2)	
		>1270		1.3 (0.8–2.4)	0.9 (0.5–1.5)	
			p for interaction	0.00	0.88	
	Women	0		0.5 (0.3–0.9)*	–	
		≤861		0.3 (0.2–0.6)	0.7 (0.3–1.7)	
		>861		0.4 (0.2–0.7)	1.0 (0.4–2.7)	
			p for interaction	0.27	1.00	

Table 2.62 (continued)

Reference	Subjects	Smoking status	Exposure categories	Odds ratio (95% CI)		Comments
Benedetti *et al.* (2006) (contd)		Cigarette–years	Drinks/week	1–6	≥7	
			Wine	1.1 (0.6–1.7)	1.2 (0.6–2.4)	
	Study I	<825		1.3 (0.8–2.1)	0.3 (0.1–0.7)	**Odds ratio for women consuming 1 or more drinks of spirits weekly compared with women who never consumed spirits on a weekly basis
	Men	825–1375		1.9 (1.0–3.8)	0.6 (0.3–1.5)	
		>1375	*p* for interaction	0.16	0.19	
	Study II	<675		0.4 (0.2–0.8)	0.6 (0.3–1.2)	
	Men	675–1270		0.5 (0.3–0.8)	0.8 (0.5–1.4)	
		>1270		0.8 (0.5–1.3)	0.8 (0.4–1.6)	
			p for interaction	0.01	0.07	
	Women	0		0.2 (0.1–0.6)	0.7 (0.2–2.5)	
		≤861		0.3 (0.2–0.7)	1.2 (0.5–2.5)	
		>861		0.2 (0.1–0.4)	0.3 (0.1–0.7)	
			p for interaction	0.83	0.27	
			Spirits			
	Study I	<825		1.3 (0.8–2.2)	1.0 (0.5–2.2)	
	Men	825–1375		1.0 (0.7–1.6)	1.0 (0.5–1.8)	
		>1375		2.2 (1.1–4.1)	1.5 (0.7–3.0)	
			p for interaction	0.41	0.67	
	Study II	<675		0.6 (0.3–1.3)	1.4 (0.6–3.1)	
	Men	675–1270		1.1 (0.7–1.8)	1.2 (0.6–2.1)	
		>1270		0.9 (0.5–1.4)	0.7 (0.4–1.2)	
			p for interaction	0.19	0.25	
	Women	0		0.8 (0.5–1.5)**	–	
		≤861		0.5 (0.3–1.0)	1.0 (0.4–2.7)	
		>861		0.3 (0.2–0.6)	1.8 (0.5–6.0)	
			p for interaction	0.92	0.80	

CI, confidence interval

2.10.5 *Studies among nonsmokers (Tables 2.63 and 2.64)*

Residual confounding by tobacco smoking is a concern when interpreting the associations between alcoholic beverage intake and lung cancer. Restricting the analysis to never smokers appears to be an effective strategy to provide further insight on this topic, although secondhand tobacco smoke might still be a concern.

Korte *et al*. (2002) reported the unpublished data from the Cancer Prevention Study (CPS) I and II (Table 2.63). In CPS I, an increased risk for lung cancer was associated with drinking ≥500 g alcohol per month among both men and women who had never smoked. This association was not observed in CPS II.

A pooled study (Freudenheim *et al*., 2005), based on seven cohorts, found an elevated pooled relative risk for alcoholic beverage consumption among never-smoking men (a dose–response was also observed), but not among never-smoking women.

Two cohort studies published subsequently reported a null association among never smokers, with adjustment for dietary factors. Both studies examined higher levels of alcoholic beverage drinking than those studied previously (Nishino et al., 2006: ≥50 g of ethanol per day [~4 drinks/day]; Rohrmann *et al*., 2006: ≥60 g of ethanol per day [~5 drinks/day]), although the number of cases at these levels of drinking was small.

Seven case–control studies included never smokers only as the study subjects or stratified analyses to never smokers (Table 2.64). [Analyses stratified to never smokers often suffer from the small number of lung cancer cases that arise among never smokers and result in wide confidence intervals.] In the three studies based on populations of never smokers (Kabat & Wynder, 1984; Koo, 1988; Hu *et al*., 2002), no significant differences in alcoholic beverage intake were found between cases and controls. [One limitation of such a design is the lack of power to examine the risk associated with heavy drinking, as it is uncommon to find heavy drinkers among never smokers. For example, Hu *et al*. (2002) compared drinkers of 1 serving/week and >1 serving per week with non-drinkers which reflects the low drinking level in this group of women and which is likely to contribute to the null association observed in this study.] In contrast, Rachtan (2002) identified a significantly elevated risk associated with even a moderate level of alcoholic beverage intake among Polish women who never smoked (e.g. odds ratio, 8.8; 95% CI, 2.8–27.3 for 4–8 g alcohol per week [approximately 0.3–0.6 drinks/week]). A strong dose–response was also observed. [The magnitude of the risk estimates seems unlikely for these levels of alcoholic beverage drinking. This result may represent a chance finding, confounding or population/environmental characteristics that are specific to this study.]

2.10.6 *Population characteristics*

There are currently no sufficient data to examine whether the effect of alcoholic beverages differ among men and women and among populations of different ethnic origins. Studies that consisted of men only or women only are often not comparable due

Table 2.63 Cohort studies of alcoholic beverage consumption and lung cancer among nonsmokers

Reference	Subjects	Exposure category	No. of cases	Risk ratio (95% CI)	Comments
Murata *et al.* (1996)	Men	*Ethanol (mL/day)*	13	1.0	Nonsmokers included never smokers and past smokers; no other adjustment [crude CI calculated from data matched on age]
		Non-drinker	10	1.3 [0.5–3.2]	
		>0–≤27	8	2.2 [0.8–6.1]	
		>27			
Korte *et al.* (2002)	*CPS I*	*Ethanol (g/month)*	Not provided		Definition of nonsmokers in CPS I: lifetime never smokers; definition of nonsmokers in CPS II: <1 cigarette–year, pipe–year or cigar–year (<0.05 pack–years)
	Men	Non-drinker		1.0	
		1–499		1.1 (1.0–1.2)	
		≥500		1.4 (1.2–1.5)	
	Women	Non-drinker		1.0	
		1–499		1.2 (0.8–1.6)	
		≥500		2.0 (1.2–3.2)	
	CPS II				
	Men	Non-drinker		1.0	
		1–499		0.95 (0.6–1.6)	
		≥500		1.2 (0.7–2.2)	
	Women	Non-drinker		1.0	
		1–499		1.3 (0.9–1.9)	
		≥500		0.6 (0.3–1.2)	
Freudenheim *et al.* (2005)		*Alcohol (g/day)*			Adjusted for education, body mass index, energy intake
	Men	0	10	1.0	
		>0–<5	16	1.5 (0.6–3.5)	
		5–<15	18	2.5 (1.1–5.8)	
		≥15	30	6.4 (2.7–14.9)	
				p for trend<0.001	
	Women	0	90	1.0	
		>0–<5	68	0.98 (0.7–1.4)	
		5–15	17	0.9 (0.5–1.5)	
		≥15	8	1.4 (0.6–2.9)	
				p for trend=0.98	

Table 2.63 (continued)

Reference	Subjects	Exposure category	No. of cases	Risk ratio (95% CI)	Comments
Nishino *et al.* (2006)	Men	*Ethanol (g/day)*			Adjusted for age, family history of lung cancer, intake of green leafy vegetables, oranges, other fruits
		Never drinker	5	1.0	
		Ever drinker	13	1.2 (0.4–3.5)	
		Current drinker			
		<25.0	7	1.1 (0.4–3.5)	
		25.0–49.9	1	0.4 (0.0–3.2)	
		≥50.0	1	1.2 (0.1–10.0)	
				p for trend=0.61	
		Former drinker	4	4.2 (1.1–15.7)	
Rohrmann *et al.* (2006)	Men and women	**Ethanol (g/day)**			All results stratified by age, sex, study centre; adjusted for height, weight, consumption of fruit, red meat, processed meat, education, physical activity, total non-ethanol energy intake; definition for never-smoking not provided
		Baseline intake			
		Non-drinker	14	0.6 (0.3–1.2)	
		0.1–4.9	44	1.0	
		5–14.9	27	0.9 (0.6–1.5)	
		15–29.9	9	0.7 (0.3–1.4)	
		30–59.9	3	0.6 (0.2–1.8)	
		≥60	0		
		Mean lifelong intake			
		Non-drinker	7	0.5 (0.2–1.2)	
		0.1–4.9	43	1.0	
		5–14.9	14	0.5 (0.3–0.8)	
		15–29.9	6	0.6 (0.3–1.5)	
		30–59.9	1	0.4 (0.1–3.0)	
		≥60	1	1.2 (0.1–13.6)	

CI, confidence interval; CPS, Cancer Prevention Study

Table 2.64 Case–control studies of alcoholic beverage consumption and lung cancer among nonsmokers

Reference	Subjects	Exposure category	Exposed cases	Odds ratio (95% CI)	Comments
Kabat & Wynder (1984)	Men and women	Not specified	Not reported	No significant difference in alcoholic beverage intake found between cases and controls for either sex	No odds ratio reported; nonsmoker defined as someone who had never smoked as much as one cigarette, pipe or cigar per day for 1 year.
Koo (1988)	Women	<1 time/week ≥1 time/week	61 27	1.0 (0.93–3.70) 1.9 *p* for trend=0.076	Never smokers defined as those who had smoked less than 20 cigarettes or pipes in the past; adjusted for age, no. of live births, schooling.
Mayne *et al.* (1994)	Men and women	*Beer (times/ month)* Q1 Q2 Q3 Q4	Not given	 1.0 (not given) 1.1 0.9 1.2 *p* for trend=NS	Nonsmokers included never smokers (not smoked more than 100 cigarettes) and former smokers (had smoked at some time but had not smoked more than 100 cigarettes in the past 10 years); adjusted for age, sex, county of residence, smoking history, cigs/day smoked by former smokers, religion, education, body mass index, income
Zang & Wynder (2001)	Men	*Current 'whiskey–equivalent' (oz/ day)* 0 1–5.9 ≥6	 23 26 4	 1.0 1.2 (0.7–2.1) 0.7 (0.2–2.0)	Nonsmokers were those who had never smoked at least one cigarette per day for at least 1 year; adjusted for body mass index, age

Table 2.64 (continued)

Reference	Subjects	Exposure category	Exposed cases	Odds ratio (95% CI)	Comments
Hu *et al*. (2002)	Women	**Servings/week**			Nonsmokers were never smokers; adjusted for age, province, education, social class
		Total alcohol			
		0	86	1.0	
		1	36	0.8 (0.5–1.4)	
		>1	35	0.8 (0.5–1.2)	
				p for trend=0.25	
		Beer			
		0	127	1.0	
		≤0.5	17	1.2 (0.6–2.4)	
		>0.5	7	0.5 (0.2–1.1)	
				p for trend=0.17	
		Wine			
		0	100	1.0	
		≤0.5	30	0.7 (0.4–1.2)	
		>0.5	25	0.7 (0.4–1.2)	
				p for trend=0.10	
		Liquor			
		0	116	1.0	
		≤0.5	17	1.1 (0.6–2.1)	
		>0.5	21	1.1 (0.6–2.1)	
				p for trend=0.58	

Table 2.64 (continued)

Reference	Subjects	Exposure category	Exposed cases	Odds ratio (95% CI)	Comments
Rachtan (2002)	Women	*Total intake (g/ week)*			Nonsmokers were lifelong nonsmokers; for total alcohol, age was adjusted; for vodka intake, adjusted for age, passive smoking, consumption of milk, butter, margarine, cheese, meat, fruit, vegetables, carrots, spinach, siblings with cancer, tuberculosis, place of residence, occupational exposures
		<1	23	1.0	
		≥1–4	15	3.9 (1.8–8.3)	
		≥4–8	7	8.8 (2.8–27.3)	
		≥8	9	12.1 (3.9–36.9)	
				p for trend<0.001	
		Usual vodka intake(g)			
		Non-drinker	23	1.0	
		<100	25	2.3 (1.1–4.9)	
		≥100	6	15.0 (2.3–96.0)	
				p for trend<0.001	
Benedetti *et al*. (2006)	Women	**Drinks/week**			Nonsmokers defined as those who never smoked regularly; adjusted for age, respondent status, ethnicity, smoking status, cigarette–years, socioeconomic status, years of schooling
		Total alcohol			
		Never weekly	25	1.0	
		1–6	3	0.2 (0.0–0.6)	
		≥7	5	1.1 (0.4–3.3)	
		Beer			
		Never weekly	31	1.0	
		≥1	2	0.5 (0.3–0.9)	
		Wine			
		Never weekly	27	1.0	
		1–6	3	0.2 (0.1–0.6)	
		≥7	3	0.7 (0.2–2.5)	
		Liquor			
		Never weekly	29	1.0	
		≥1	4	0.8 (0.5–1.5)	

CI, confidence interval; NS, not significant

to the different levels of alcoholic beverage exposure in these studies. A few studies conducted analyses stratified by gender using the same exposure categories (Williams & Horm, 1977; Bandera *et al*., 1997; Prescott *et al*., 1999; Korte *et al*., 2002 [CPS I and CPS II]; Pacella-Norman *et al*., 2002; Freudenheim *et al*., 2005; Benedetti *et al*., 2006; Rohrmann *et al*., 2006). There was no obvious heterogeneity between genders based on results of total alcoholic beverage consumption and risk for lung cancer. However, heterogeneity may exist when level of smoking, type of alcoholic beverage and histological type of lung cancer are considered.