

Alcohol drinking, social class and cancer

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This chapter reviews the data on occurrence of cancers that are potentially caused by alcohol drinking (cancers of the upper gastrointestinal and respiratory tracts, and liver cancer) in relation to social class. In order to assess the role of alcohol drinking in the observed social class gradients of these cancers, we have particularly looked for consistency in the gradients of different alcohol-related cancers, and used lung cancer occurrence to judge the role of tobacco smoking, which is the major other determinant of these diseases. Additional data on levels of alcohol drinking and on the occurrence of other alcohol-related morbidity are brought into the discussion where available. A role of alcohol drinking in the observed negative social class gradients for alcohol-related cancers is very likely in men in France, Italy and New Zealand. Evidence that is less strong, but is suggestive of a role of alcohol drinking, is seen for men in Brazil, Switzerland, the United Kingdom and Denmark. Although a role of alcohol drinking is likely or possible in certain populations, other factors may contribute as well, most notably tobacco smoking and dietary habits. Additional data on the frequency of complications after surgical procedures in alcohol drinkers are reviewed briefly.

Alcohol drinking is causally associated with cancers of the mouth and pharynx, oesophagus, larynx and liver (IARC, 1988). To the extent that alcohol drinking varies between different social classes, it may therefore contribute to the observed associations between social class and the risk of these particular cancers. The purpose of this chapter is to analyse the data that are presented in detail in the chapter by Faggiano *et al.* from this perspective, and review additional information from published sources regarding the association between social class and alcohol drinking in different populations. A general discussion of social determinants of alcohol use or alcohol abuse falls outside the scope of the chapter. Finally, data are reviewed on the association between alcohol drinking and the frequency of complications after surgical procedures. This may be relevant to the understanding of social class differences in survival after cancer diagnosis.

Alcohol drinking and cancer risk

Epidemiological studies have established with certainty that alcohol drinking is a strong risk factor for cancers of the upper gastrointestinal and respiratory tracts and for cancer of the liver (IARC, 1988). For example, a recent cohort study of alcohol abusers in Copenhagen, Denmark showed highly elevated

risks of cancers of the mouth and pharynx, oesophagus, larynx and liver (Tønnesen *et al.*, 1994; Table 1). Cancer of the lung also occurred more frequently than expected in this cohort but this excess was thought to reflect confounding by tobacco smoking rather than a causal effect of alcohol drinking on lung cancer occurrence. The mechanisms by which the consumption of alcoholic beverages increases the risk of cancer are not known (Seitz *et al.*, 1992). Some cancers of organs other than those of the upper gastrointestinal and respiratory tracts have also been associated with alcohol drinking, but these associations are not established conclusively at the present time, and the possible relative risks involved are lower than those for cancers of the mouth and pharynx, oesophagus, larynx and liver.

Cancers of the upper gastrointestinal and respiratory tracts

Both alcohol drinking and tobacco smoking contribute to the risk of cancers of the upper gastrointestinal and respiratory tracts. Studies of alcohol drinking in non-smokers and of tobacco smoking in non-drinkers have confirmed that each habit is truly a risk factor for cancer, even in the absence of the other (La Vecchia & Negri, 1989; Talamini *et al.*, 1990). For these diseases, it has been found consistently

Table 1. Numbers of cases (*n*), relative risks (RR) and 95% confidence intervals (CI) for selected cancers in a cohort of alcohol abusers^a

Cancer site	Men			Women		
	<i>n</i>	RR	95% CI	<i>n</i>	RR	95% CI
Mouth and pharynx	112	3.6	3.0–4.3	22	17.2	10.8–26.0
Oesophagus	57	5.3	4.0–6.9	2	4.9	0.6–17.7
Larynx	65	3.7	2.8–4.7	1	2.2	0.6–12.2
Liver	38	4.1	2.9–5.6	1	1.6	0.0–8.9
Lung	456	2.5	2.3–2.7	29	3.7	2.5–5.4

^aData from Tønnesen *et al.*, 1994.

that the combination of alcohol drinking and tobacco smoking adds more to the absolute risk than the sum of the two factors separately (Tuyns *et al.*, 1977; Blot *et al.*, 1988; Tuyns *et al.*, 1988). For example, in one case-control study in France, the relative risk of oesophageal cancer in persons who were in the highest category of both alcohol drinking and tobacco smoking was 44.4, compared with persons in the lowest category for both factors; however, the relative risks associated with high alcohol drinking alone and with high tobacco smoking alone were 18.0 and 5.1, respectively (Tuyns *et al.*, 1977). When such an interaction between two factors is present, a large proportion of the excess cases of cancer is attributable to the combination of the two factors.

The high relative risks of cancer of the mouth and pharynx, oesophagus and larynx (as seen in the Danish cohort study; Table 1) therefore reflect not only the pure effect of alcohol drinking but also the interaction with tobacco smoking. The separate effects of alcohol and tobacco can be distinguished only if both factors are recorded accurately for each individual in the study and if a sufficient proportion of individuals in the study population have only one of the two habits. It is well known that smoking and drinking tend to occur together in individuals, and that most heavy drinkers smoke tobacco as well (Johnson & Jennison, 1992). In addition, other determinants of cancer risk – for example, dietary habits – may be suspected to be associated with educational level, tobacco smoking and alcohol drinking (La Vecchia *et al.*, 1992).

An important finding is that the relative risk of cancers of the upper gastrointestinal and respiratory tracts is particularly increased at very high levels of alcohol consumption. In the case-control study from France, for example, the relative risk of oesophageal cancer appeared to increase only above a daily consumption of 40 g of ethanol per day and five- to 10-fold increases in risk were seen only above 60 g of ethanol per day (Tuyns *et al.*, 1977). This suggests that the behaviour of main relevance to cancer risk, and to the possible influence of alcohol drinking on the observed associations between social class and cancer occurrence, is a high level of alcohol consumption. The frequency of heavy drinking, alcohol abuse or alcoholism may thus be more relevant than variation within the low range of alcohol drinking.

The association of cancers of the upper gastrointestinal and respiratory tracts with alcohol drinking and tobacco smoking may vary for different subtypes of these diseases. Cancers of the lip, salivary glands and nasopharynx, which are often tabulated as part of cancer of the mouth and pharynx, are probably associated with alcohol to a lesser extent (if at all) than other parts of the mouth and pharynx are (Tønnesen *et al.*, 1994). Within the oesophagus, the association with alcohol and tobacco is certain for squamous-cell carcinoma, which most often occurs in the middle or upper part of the organ, but adenocarcinoma occurring at the junction between the oesophagus and the stomach is probably related to smoking and drinking to a smaller extent, if at all (Levi *et al.*, 1990). Within the larynx, cancers of the supraglottis are etiologically

similar to cancers of the mouth and pharynx and are associated with alcohol drinking and tobacco smoking. Cancers of the glottis are etiologically more similar to lung cancer and highly associated with tobacco smoking but less strongly with alcohol drinking (Tuyns *et al.*, 1988).

Cancer of the liver

The association between alcohol drinking and liver cancer is probably associated mainly with a relatively high intake of alcoholic beverages (Corrao *et al.*, 1993) and may be mediated by the effect of alcohol drinking on the occurrence of liver cirrhosis (Adami *et al.*, 1992). Like the other alcohol-related cancers discussed above, liver cancer may be associated with tobacco smoking (Yu *et al.*, 1988), but the role of smoking is smaller for liver cancer than for cancers of the upper gastrointestinal and respiratory tracts.

Causes other than drinking and smoking

It should be emphasized that all the diseases that are associated with alcohol drinking, either alone or in combination with tobacco smoking, have other causes as well. Although alcohol and tobacco are strong determinants of the risk of these diseases in most if not all human populations, the pattern of occurrence of these diseases cannot be understood solely in terms of these two risk factors. Dietary factors in particular are suspected of playing a role in the etiology of these diseases as well, with a diet rich in vegetables and fruit probably having a protective effect (Negri *et al.*, 1991). In some populations, particularly in developing countries, hepatocellular carcinoma is strongly associated with hepatitis caused by the hepatitis B and C viruses (IARC, 1994), and it is suspected that dietary intake of some mycotoxins (for example, aflatoxin) also increases the risk (IARC, 1993). Dietary habits and viral infections may themselves be associated with social class, and can therefore contribute to the observed social class differences in cancer occurrence. For discussion of the role of these factors, see other chapters of this book.

International patterns of social class differences in alcoholic-beverage consumption and occurrence of alcohol-related cancers

The social class gradients for cancers known to be associated causally with alcohol drinking (mouth,

pharynx, oesophagus, larynx and liver) are shown in Table 2 (mortality) and Table 3 (incidence). In addition, lung cancer is included in the tables because this disease serves as an indicator of the frequency of tobacco smoking in different social classes in the populations studied. The occurrence of alcohol-related cancers is clearly associated with low social class, although the pattern is not totally uniform. The direction of the social class gradient is indicated with plus or minus signs: a minus sign indicates a negative association between social class and cancer risk – that is, low social class associated with high risk; a plus sign indicates a positive association. The number of signs indicates approximately the strength of the association as indicated by the relative difference in risk between the extreme groups of social class.

Brazil

In Brazil, social class was negatively associated with mortality from alcohol-related cancers, including cancer of the liver. The gradient for lung cancer, however, was in the opposite direction. This suggests that alcohol drinking, but not tobacco smoking, may explain a part of the observed social class gradient for cancers of the pharynx, oesophagus, larynx and liver in Brazil. Bouchardy *et al.* (1993) suggested that the gradient in oesophageal cancer could be explained by the higher use of sugar-cane spirit, black tobacco and mate in the lower social classes. This explanation may apply to cancers of the mouth, pharynx and larynx as well.

Colombia

In contrast to most other populations, the pattern of incidence of alcohol-related cancers in Colombia tended to show positive social class gradients. The only strong, negative association was for pharyngeal cancer in women, but no gradient was seen in women for oral cancer and the gradient for oesophageal cancer was less strong than that for pharyngeal cancer. The positive associations for lung cancer, laryngeal cancer and cancer of the mouth suggest a role of tobacco smoking in the positive social class gradients for these cancers. Cuello *et al.* (1982) suggested that the gradients in men could be due to differences in the type of tobacco smoked (predominantly black tobacco in the lower classes), and that the type of alcohol used by the lower classes (aguardiente) is a relatively pure substance,

Table 2. Social class gradients of the mortality from alcohol-related cancers and lung cancer

Country	Sex	Mouth	Pharynx	Oesophagus	Larynx	Liver	Lung
Brazil (Bouchardy <i>et al.</i> , 1993)	M	0	--	--	--	-	++
	F					-	++
Mouth & pharynx							
Canada (R. Wilkins, pers. commun.)	M ^a	--				--	--
	F ^a	--					-
	M ^b	--				0	--
	F ^b						-
France (Desplanques, 1985)	M ^c	----		----	----		--
	M ^d	----		----	----		-
Italy (Faggiano <i>et al.</i> , 1995)	M	--		--	--	-	0
	F	0				-	0
Japan (Hirayama, 1990)	M	0		0	0	0	0
	F	0		0	0	0	+
New Zealand (Pearce & Howard, 1986)	M	--		0	----	--	--
	M ^e	----		--	----	----	--
Switzerland (Levi <i>et al.</i> , 1988; C.E. Minder, pers. commun.)	M ^f	--		--	--	0	-
	F ^f	0		0	0	0	0
	M	--		--	--	0	--
United Kingdom (England & Wales) (OPCS, 1977)	M	0		-	--	-	--
	F	-		--	--	0	--
United Kingdom (Great Britain) (OPCS, 1990)	M	--		--	----	--	--
	F	--		--	----		--
United Kingdom (London) (Davey Smith, 1991)	M			--			--
USA (California) (Buell <i>et al.</i> , 1960)	M	-		--			0

-, Negative association; +, positive association; 0, no association; -/+, gradients less than two-fold; - -/+, gradients two- to five-fold; -- -/+, gradients five-fold or higher. For details of the studies, see the chapter in this volume by Faggiano *et al.*
^a1986 census data. ^b1971 census data. ^cAge 45-54 years. ^dAge 55-64 years. ^eN.E. Pearce, pers. commun. ^fCombined analysis of cancers of the mouth, pharynx, oesophagus and larynx.

free of tannins or other contaminants introduced by fermentation processes.

Japan

The mortality data from Japan did not suggest any association between alcohol-related cancers and social class. Similarly, the cohort study of Hirayama (1990) showed no association between social class and mortality from liver cirrhosis in men, but women in the highest social classes had a slightly elevated mortality from liver cirrhosis.

France

Mortality data for French men show strong negative associations between social class and the risk of alcohol-related cancers. The gradient for lung cancer was in the same direction, but less strong.

Desplanques (1985) showed strong negative social class gradients for mortality from liver cirrhosis and from alcoholism in French men. A similar, but less strong, pattern was seen in women.

Based on data from a survey in Lorraine, d'Houtaud *et al.* (1989) concluded that a greater

proportion of men of high socioeconomic status than of low status regularly consumes alcohol, but those of higher socioeconomic status consume smaller amounts of alcohol per drinking occurrence. Among those of lower socioeconomic status, there were both more abstainers and more heavy drinkers. A greater proportion of women in higher social classes than of lower socioeconomic status were regular consumers, but the amounts consumed by women were considerably lower than those consumed by men.

The social class pattern of cancer mortality in men in France suggests a strong involvement of both alcohol drinking and tobacco smoking.

Italy

In Italy, negative associations were seen between social class and the incidence of and mortality from alcohol-related cancers, particularly in men, but the gradients were less strong than in France. The mortality data showed no social class effect on lung cancer, but in the incidence data on lung cancer

Table 3. Social class gradients of the incidence of alcohol-related cancers and lung cancer

Country	Sex	Mouth	Pharynx	Oesophagus	Larynx	Liver	Lung
Colombia (Cuello <i>et al.</i> , 1982)	M	+	0	0	++	0	+
	F	0	---	-	+	0	0
Canada (Burbonnais & Siemiatycki, M ^b in press)	M ^a		-				--
	M ^c		--		--	--	--
Denmark (Lynge & Thygesen, 1990)	M	--	-	-	--	-	--
	F	0	0	+	--	--	--
Finland (Pukkala, 1995)	M	0	0	--	--	0	--
	F	0	-	----	-	0	0
Mouth & pharynx							
Italy (Milan) (Ferraroni <i>et al.</i> , 1989)	M+F ^b	---		--		--	
	M+F ^d	--		--		-	
Italy (Torino) (Faggiano <i>et al.</i> , 1994)	M ^b	-			--		--
	F ^b	0					++
	M ^e	--			--		-
	F ^e						++
	M ^f	-					-
	F ⁱ	--					-
Sweden (Vågerö & Persson, 1986)	M	0	0	0	0	0	0
	F	0	--	0	0	0	0
United Kingdom (England & Wales) (Kogevinas, 1990)	M	0		0	--	0	--
	F			-			
USA (Williams & Horm, 1977)	M ^b	0	-	-	--	-	-
	F ^b	+	+	0	+	0	-
	M ^a	0	-	0	0	0	-
	F ^a	0	0	-	0	+	-

-, Negative association; +, positive association; 0, no association; -/+, gradients less than two-fold; --/++, gradients two- to five-fold; ---/+++, gradients five-fold or higher. For details of the studies, see the chapter in this volume by Faggiano *et al.*

^aIncome level. ^bEducation. ^cOccupational prestige scale. ^dSocial class. ^eOccupational group. ^fHousing tenure.

there were tendencies towards negative associations in men but in women the associations were positive. The incidence of liver cancer was associated with social class about as strongly as the other alcohol-related cancers. Faggiano *et al.* (1994) attributed the negative associations with mouth and pharynx cancer in men partly to the known negative association between alcohol drinking and low educational level in Italian men. The negative gradients for laryngeal cancer in men probably reflect both alcohol drinking and tobacco smoking.

A strong association between low educational level and mortality from liver cirrhosis has been observed in Italy (F. Faggiano, pers. commun.). Both men and women who had not completed primary-school education had a three- to fivefold higher mortality from cirrhosis than those with a university education.

In a case-control study on digestive tract neoplasms, the observed social class gradients for cancers of the mouth and pharynx and of the oesophagus were attenuated by adjustment for smoking and alcohol drinking (Ferraroni *et al.*, 1989). This provides direct evidence that the social class gradients are partly due to smoking and drinking.

Overall, the data suggest a strong role of alcohol drinking in the social class gradient of cancers of the mouth and pharynx, oesophagus, larynx and liver in Italy. In men in particular, tobacco smoking probably contributes as well.

Switzerland

In Switzerland, the two available analyses of mortality data suggested a negative social class gradient in men for cancers of the mouth and pharynx, oesophagus and larynx. However, the gradient for lung cancer was of similar magnitude and no association was seen between social class and liver cancer in this population. This pattern suggests a stronger role of tobacco smoking than alcohol drinking in the social class gradient of cancers of the mouth and pharynx, oesophagus and larynx in this population.

A survey performed among patients at two hospitals in the French-speaking part of Switzerland, however, reported an association between alcoholism and low socioeconomic class (Trisconi *et al.*, 1989). The prevalence of cigarette smoking was 60% in alcoholics and 29% in other patients.

In a combined analysis of population samples from Italy, Spain, Switzerland and France, the

average daily consumption of alcohol ranged from 21.5 g in professionals to 40.1 g in manual workers (Péquignot *et al.*, 1988). The average consumption in women was lower, around 6–8 g per day, and did not vary between occupational groups. A similar analysis of tobacco smoking showed little association with occupational group in men, but white-collar and professional women smoked more than women in lower occupational groups (Berrino *et al.*, 1988).

Sweden

Cancer incidence data from the Nordic countries did not consistently show any social class gradient in the occurrence of alcohol-related cancers. In Sweden, no association was seen except for pharyngeal cancer which, in women only, was negatively associated with social class. This may be a chance occurrence or a phenomenon unrelated to alcohol drinking.

Data from the cross-sectional Stockholm Health of the Population Study showed small differences between mean alcohol consumption and the prevalence of high consumers in various socioeconomic and educational groups in both men and women (Romelsjö, 1989). Self-employed men had a higher consumption than other groups (14.8% consuming more than 35 g of ethanol per day compared with 9.3% in the survey overall). A review of other studies in the same geographical area indicated a change over time in the social pattern of alcohol consumption (Halldin, 1985; Romelsjö, 1989). In the 1960s and 1970s, the higher social classes had a higher proportion of high alcohol consumers than the lower classes for both men and women. In the 1980s, a different pattern has emerged. In young people, high alcohol consumption is associated with low social class and low educational level. In older people, high alcohol consumption remains associated with high social class and high educational level.

A prospective study from Lundby in the south of Sweden showed a strong association between both low social class and low educational level and the probability of developing alcoholism in a 15-year period of follow-up (Öjesjö *et al.*, 1983).

Finland

In men in Finland, negative associations with social class were seen for oesophageal and laryngeal cancers. The absence of a similar effect on cancers of the

mouth, pharynx and liver, and a negative association between social class and lung cancer, suggest a stronger role of tobacco smoking than alcohol drinking in the social class gradient for oesophageal and laryngeal cancer in Finnish men. In women, however, negative gradients were seen for cancers of the pharynx, oesophagus and larynx, but the data on liver cancer and lung cancer showed no dependence on social class. This is somewhat similar to the situation in Swedish women, and it is possible that factors other than alcohol drinking and tobacco smoking are responsible for the social class trends of cancers of the pharynx, oesophagus and larynx in women in these countries.

Aro *et al.* (1986) studied health-related habits in a sample of white-collar and blue-collar workers in Finland. In men, the frequency of heavy alcohol intoxication was highest in the blue-collar workers, but the white-collar workers generally consumed alcohol more frequently than the blue-collar workers. Female white-collar workers generally consumed alcohol more often than blue-collar workers, and they also had a higher frequency of heavy alcohol intoxication. Particularly among women, tobacco smoking was highest in the blue-collar workers. A study of hospital admissions in Finland showed associations between low social class and admission for alcohol poisoning, alcoholism and alcoholic psychosis (Poikolainen, 1982, 1983). The associations were stronger for men than for women. No association was seen between liver cirrhosis and low social class. It was speculated that liver cirrhosis depends most strongly on daily heavy drinking, which is more common in the upper social classes. The lower classes tend to concentrate their drinking in episodes of intoxication interspersed with periods with abstinence; this pattern may carry a higher risk of alcohol poisoning, alcoholism and alcoholic psychosis.

Denmark

In Denmark, the data in men consistently showed a negative association between social class and incidence of alcohol-related cancers and lung cancer, suggesting that both alcohol drinking and tobacco smoking contribute to the social class gradients of alcohol-related cancers. In Danish women, negative social class gradients were seen for cancers of the larynx, liver and lung. The gradients in laryngeal cancer and lung cancer are probably due to differences in tobacco smoking, but the negative gradi-

ent in liver cancer, with no accompanying negative trend in cancers of the mouth, pharynx and oesophagus, is more difficult to explain. Chronic infections with hepatitis B and C viruses are rare in the Danish population.

In the Glostrup Population Studies, alcohol consumption was described by social class and employment status by Sælan *et al.* (1992). In both men and women, the average number of drinks per week was highest in the lower social classes. Analysis by employment status showed that, among men, self-employed persons had the highest consumption and salaried employees the lowest. In women, salaried employees had the highest consumption and workers the lowest.

United Kingdom

The recent mortality data from the United Kingdom showed a fairly consistent pattern with negative associations in both men and women between social class and the alcohol-related cancers and lung cancer. The incidence data, however, were less consistent and the negative associations were largely confined to laryngeal cancer and lung cancer.

Kogevinas (1990) noted that alcohol consumption varies between social classes in the United Kingdom, and that about a quarter of men in manual occupations were classified as heavy drinkers compared with around 10% in non-manual occupations. He noted also, however, that social class variation in tobacco smoking is pronounced, with 33% of both male and female professionals and 64% of male and 42% of female unskilled workers being smokers.

Other studies of social class and alcohol drinking in the United Kingdom have shown no or weak associations. One study in Northern Ireland showed a higher prevalence of problem-drinking in skilled manual workers than in professionals and managers (Murray & McMillan, 1993); another study in Wales showed a tendency of higher prevalence of consuming 22 drinks or more per week in the higher social classes (Farrow *et al.*, 1988). In a study of three regions of the United Kingdom, the weekly alcohol consumption increased with household income in both men and women, and, among men, manual workers drank more alcohol than nonmanual workers (Crawford, 1988). In a sample of attendees at a London health centre, no association was seen between social class and high alcohol consumption (King, 1986).

If it is assumed that the gradients with social class suggested by the mortality data are correct, then the roughly similar associations of social class with alcohol-related cancers and lung cancer, and the lack of consistent association between social class and drinking in the United Kingdom, suggest that a major part of the social class gradients in the United Kingdom may be due to differences in tobacco smoking.

Canada

The available data from Canada showed a negative association between social class and cancers of the mouth and pharynx, oesophagus, liver and lung. This pattern may suggest a role of both tobacco smoking and alcohol drinking in the social class gradients for cancers of the mouth and pharynx, oesophagus and liver in Canada.

New Zealand

The data on cancer mortality in men in New Zealand showed very strong negative associations with social class – about as strong as those seen in France. Since both liver cancer and lung cancer are strongly negatively associated with social class, it is possible that the social class gradient in cancers of the mouth and pharynx, oesophagus and larynx are due to strong social class differences in both alcohol drinking and tobacco smoking.

Data published by Pearce *et al.* (1983) showed negative social class gradients for most broad disease groupings. The category 'mental disorders', which includes predominantly deaths from alcoholism, alcoholic psychosis and drug dependence, was much over-represented in the lowest classes. This, together with the strong social gradient for liver cancer, suggests a strong role of alcohol drinking in the observed gradients for cancers of the upper gastrointestinal and respiratory tracts in New Zealand.

Pearce and Howard (1986) presented crude relative risks for different social classes, and expected relative risks, the latter taking into account the known social class differences in tobacco smoking, based on census information. The authors considered that the smoking pattern may explain much of the elevated risks of cancers of the mouth and pharynx, oesophagus and larynx in social classes III and IV, but not the very high risks of these cancers in social class V. Alcohol drinking may in particular contribute to the high risks in this social class.

In addition, Pearce and Howard considered that chronic infection with hepatitis B virus may contribute to mortality from liver cancer in some parts of New Zealand.

Casswell and Gordon (1984) studied self-reported alcohol consumption in various occupational and social groups in New Zealand. The pattern of high frequency of drinking low quantities of alcohol was most common in the higher social classes; the pattern of drinking high quantities less often was more common in the lower social classes. An average daily consumption of more than 100 ml of ethanol was most frequent in the lowest social classes. Additional data on liver cirrhosis mortality showed a low mortality from this disease in the highest social class (standardized mortality ratio = 0.23) and a very high mortality in the lowest class (standardized mortality ratio = 3.59).

United States of America

In men in the United States, cancers of the mouth and pharynx, oesophagus, larynx, liver and lung tended to show negative associations with social class. This suggests that both alcohol drinking and tobacco smoking may contribute to the gradients. In women in the United States, the association between social class and alcohol-related cancers tended to be positive.

The paper by Williams and Horm (1977) confirmed the suspected associations between social class and smoking and drinking. In men, years of education was negatively associated with cigarette smoking and total alcohol consumption. In women, years of education and family income were positively associated with both drinking and smoking. Tobacco smoking and alcohol drinking were positively associated in both men and women.

Surveys were conducted of alcohol drinking patterns in 48 states in the United States in 1984 and 1990 (Midanik & Clark, 1994). In men and women combined, weekly drinking was more frequent in households with above-median income and in persons with a high educational level. However, for more heavy consumption, indicated by the consumption of five or more drinks on one occasion, the opposite trends were seen and the highest responses occurred in households with below-median income and in persons with a low level of education. The survey indicated large variations in alcohol drinking in different regions of the USA.

In the Healthy Worker Project, conducted among employees in Minneapolis-St Paul, the frequency of alcohol drinking was associated with high socioeconomic status in women, but no association was seen in men (Jeffery *et al.*, 1991). In both men and women, tobacco smoking was strongly associated with low socioeconomic status.

A combined analysis of 10 surveys of alcohol drinking in a total sample of 9900 persons was reported by Knupfer (1989). The analysis attempted to distinguish different patterns of drinking in nine categories ranging from lifelong abstention to frequent drunkenness. Six social class groups were constructed by a combination of educational and income levels. In men, the frequency of abstention decreased from 35% in the lowest social class to 5% in the highest. The categories from frequent light drinking to moderately heavy drinking were associated with high social class; the frequency increased from 34% in the lowest class to 69% in the highest. Finally, the category indicating frequent drunkenness was weakly inversely associated with social class and decreased from 19% in the lowest social class to 15% in the highest. In particular, the highest category of drinking decreased from 6% to 2%. In women, the patterns were qualitatively similar to those in men, but the proportion of abstainers was higher and the proportion of drinkers lower than in men in all categories of social class.

Alcohol drinking and the frequency of complications after surgery

Treatment of many cancers involves a surgical resection of the tumour. An effect of alcohol drinking on the probability of postoperative complications may, therefore, contribute to the observed social class differences in survival after cancer diagnosis in populations where alcohol drinking is associated with social class. A series of studies by Tønnesen and colleagues in Denmark have shown that persons with a high consumption of alcohol at the time of operation have an increased risk of postoperative complications. Persons with a high alcohol consumption constitute 7–20% of those undergoing surgery, but carry the burden of more than half of the total postoperative morbidity. An influence of social class per se on postoperative morbidity has not been investigated except in one small uncontrolled study of eight men undergoing amputation (Hunter & Middleton, 1984).

In a retrospective study of 73 alcoholics and 73 matched controls, the postoperative morbidity after transurethral resection of the prostate was 62% and 20%, respectively (Tønnesen *et al.*, 1988). The most common complications were infection and bleeding episodes. Bacterial infections occurred more often in the group of alcohol abusers, but the types of bacteria found in infected persons were similar in abusers and controls.

In a retrospective study of 90 alcohol abusers and 90 matched controls, the postoperative morbidity after osteosynthesis of malleolar fractures was increased in the alcohol abusers (33% versus 9%) (Tønnesen *et al.*, 1991). The excess was particularly due to infections. The long-term outcome was also poorer in the group of alcohol abusers, who required more reoperations.

The postoperative course after evacuation of subdural haematoma was studied in a group of 106 patients (Sonne & Tønnesen, 1992). In the one-third of the patients who drank more than 60 g of ethanol per day, an increased postoperative morbidity and mortality was seen.

The postoperative morbidity after hysterectomy was studied prospectively in 229 consecutive patients; the frequency of complications was 80% in alcohol abusers (more than 60 g of alcohol per day), 27% in social drinkers (25–60 g per day) and 13% in the group of women who consumed less than 25 g of alcohol per day (Felding *et al.*, 1992).

A prospective study was reported of 30 persons undergoing colorectal resection (15 noncirrhotic alcohol misusers who had consumed at least 60 g of alcohol per day for several years and a matched control group of 15 persons who consumed less than 25 g of alcohol per day) (Tønnesen *et al.*, 1992). The group of alcohol abusers developed complications more often than controls (10 persons versus three) and stayed longer in hospital after surgery (median 20 days versus 12). Detailed data were collected that indicated that the effects could be due to alcohol-induced dysfunction of the heart, suppression of the cellular immune system and haemostatic imbalance.

Other studies of alcohol abusers have shown an effect on postoperative morbidity, but these studies did not evaluate alcohol consumption at the time of surgery (Kleeman & Zöller, 1986; Nguyen *et al.*, 1990). Liver transplantation for alcoholic cirrhosis has been performed without development

of more complications in selected alcoholics who had abstained from alcohol for several months before surgery (Knechtle *et al.*, 1992; Lucey *et al.*, 1992; McCurry *et al.*, 1992).

Conclusions

Clear differences have been demonstrated in disease occurrence between social classes and between groups with different levels of education. Most often we would not think of class or educational level as the cause of disease *per se*, but rather seek to identify the correlates of these variables that are more directly involved in the causation of the diseases. In this context, we would not think of alcohol drinking as a potential confounder of the association between social class and cancer, but merely as a mechanism underlying an association between social class and cancer risk, or as an aspect of social class that associates class with cancer risk.

The theoretical line of argument of this chapter responds to the following question: can the observed variation in cancer incidence and mortality by social class be attributed to alcohol drinking? To answer this question, attention can be restricted to the cancers with which alcohol drinking is causally associated (cancers of the mouth, pharynx, oesophagus, larynx and liver), and to the populations where social class variation in such cancers has been observed. We have put the main emphasis on the consistency of the social class pattern of the different alcohol-related cancers, because, if the social class variation in alcohol drinking is sufficiently strong to lead to an increase or decrease in one of these cancers a similar pattern would be expected to follow in the other alcohol-related cancers. For this reason we have used as the point of departure a tabulation of the social class gradients of alcohol-related cancers, and discussed, as secondary data, levels of alcohol drinking as assessed by different methods, occurrence of other alcohol-related diseases and occurrence of lung cancer (a good indicator of tobacco smoking).

The clearest evidence of a role of alcohol drinking in social gradients in cancer risk is found in men in France and Italy. In these populations, wine has traditionally been consumed with meals and particularly so among those of lower social classes such as agricultural and manual workers. These countries rank among the highest in the world in per capita levels of alcohol consumption. The con-

sistency of the social class effect across the alcohol-related cancers and the stronger gradient for these cancers than for lung cancer increase our confidence in alcohol drinking as the main or at least a major contributory factor in the social class gradients. This interpretation is also supported by the finding of similar social class gradients in liver cirrhosis in both men and women in France and Italy.

The only other population where a very strong social class gradient can be clearly linked to alcohol drinking is that of New Zealand. As in France, the gradients of alcohol-related cancers are even stronger than for lung cancer, and additional studies of alcohol drinking, alcohol-related psychiatric morbidity and liver cirrhosis in relation to social class has confirmed a high level of these parameters in the lowest social classes of men in New Zealand. As for France and Italy, the data on women are inadequate for an assessment of the role of alcohol drinking.

There are few other populations where a social class gradient is seen consistently for the cancers known to be caused by alcohol drinking, but patterns suggestive of a role of alcohol drinking are seen in Brazil, Switzerland, United Kingdom and Denmark. The situation in Brazil is interesting, with opposite social class trends for alcohol-related cancers and lung cancer; thus, tobacco smoking can be effectively ruled out as an explanation for the observed negative social class gradients. In Switzerland, the situation may be similar to France and Italy, with habitual wine drinking among lower social classes being a factor of importance. In the United Kingdom, the mortality data were suggestive of social class gradients but no such pattern was seen in the incidence data. Finally, in Denmark, fairly consistent but not very strong negative social class gradients were seen. A role of alcohol drinking is possible and supported by some evidence of a higher level of alcohol drinking in the lower social classes in Denmark.

It is emphasized that although a role of alcohol drinking in the social class gradients of the relevant cancers is very likely in men in France, Italy and New Zealand, and probable in some other populations, other factors may contribute as well. In particular, a role of tobacco smoking is likely, as indicated by the parallel gradients in lung cancer. Dietary factors may be another main contributing

factor in the social class gradients of tobacco-related cancers.

Survival after cancer diagnosis is related to surgical intervention and to other parameters. The influence of social class on postoperative morbidity has not been investigated properly, but there is plenty of evidence of association between social class and survival after cancer diagnosis (see the chapter by Kogevinas and Porta in this book). An effect of alcohol on postoperative morbidity has been observed for a range of different surgical procedures, and consists of increased frequency of infections, bleeding episodes and cardiopulmonary insufficiency. These complications are probably due to preoperative disturbances of the cellular immune system, haemostasis and heart function. Since most of the quoted studies compared alcohol abusers with people who did not abuse alcohol, it is not clearly established what level of alcohol consumption is required for the adverse effect on postoperative morbidity. However, at present it may be concluded that in populations where there is an association between alcohol abuse and low social class, the effect of alcohol abuse on postoperative morbidity may contribute to the observed negative social class gradients in survival after cancer diagnosis.

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