

Cigarette and alcohol consumption and the risk of colorectal cancer in Shanghai, China

B-T Ji¹, Q Dai², Y-T Gao², A W Hsing¹, J K McLaughlin³, J F Fraumeni Jr¹, W-H Chow¹

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The relation of cigarette smoking and alcohol drinking to colorectal cancer risk has been inconsistent in the epidemiological literature. In a population-based case-control study of colorectal cancer in Shanghai, China, where the incidence rates are rising sharply, we examined the association with tobacco and alcohol use. Cases were aged 30–74 years and newly diagnosed with cancers of the colon ($N=931$) or rectum ($N=874$) between 1990 and 1992. Controls ($N=1552$) were randomly selected among Shanghai residents, frequency-matched to cases by gender and age. Information on lifetime consumption of tobacco and alcohol, as well as demographic and other risk factors, was obtained through in-person interviews. Associations with cigarette smoking and alcohol use were estimated by odds ratios (ORs) and 95% confidence intervals (CIs). Among women, the prevalence of smoking and alcohol drinking was low, and no significant association with colon or rectal cancer was observed. Although cigarette smoking among men was not related overall to colon or rectal cancer risk, there was a 50% excess risk of rectal cancer (OR 1.5, 95% CI 0.9–2.5) among those who smoked 55 or more pack-years. Among men, former alcohol drinkers had an increased risk of colon cancer (OR 2.3, 95% CI 1.4–3.7) but not rectal cancer, while current drinkers had a 30–50% excess risk of colon cancer only among those with long-term (30+ years) and heavy (>560 g ethanol/week) consumption. The excess risks were mainly associated with hard liquor consumption, with no material difference in risk between proximal and distal colon cancer. Although cigarette smoking and alcohol drinking in general were not risk factors for colorectal cancers in Shanghai, there were small excess risks for rectal cancer among heavy smokers and colon cancer among heavy drinkers.

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Key words: colorectal cancer, tobacco smoking and alcohol, case-control study, Shanghai

Introduction

Colorectal cancer is a major cause of cancer death in Western Europe and North America (Boyle *et al.*, 1985; Parkin *et al.*, 1997, 2001). While cigarette smoking has been associated with the risk of adenomatous polyps in most studies, the epidemiological evidence linking smoking to colorectal cancer is less consistent (Potter *et al.*, 1993; Giovannucci and Martínez, 1996; Nyrén *et al.*, 1996; Potter, 1999; Stürmer *et al.*, 2000; Terry *et al.*, 2001). The relation of alcohol use to colorectal cancer is also inconclusive, with some studies reporting weak or moderate excess risks, and others indicating no association (Kune and Vitetta, 1992; Franceschi and La Vecchia, 1994). A meta-analysis based on 27 epidemiological studies reported a 10% excess risk for colon and rectal cancers among those who had at least two

alcoholic drinks daily (Longnecker *et al.*, 1990). Although earlier studies implicated beer consumption more than wine or liquor, the relation to specific types of alcoholic beverages has been inconsistent (Kune and Vitetta, 1992).

We conducted a population-based case-control study of colorectal cancer in Shanghai, China, where incidence rates have been rising sharply over the past two decades (Ji *et al.*, 1998). The age-adjusted colon cancer incidence rates increased about 50% or 2% per year from 1972–77 to 1990–94 among both men (from 14 to 22 per 100 000 person-years) and women (from 12 to 19 per 100 000 person-years). Herein we assess the relation to smoking and drinking. These practices are uncommon among Shanghai women. However, the prevalence of cigarette smoking among men currently surpasses 60% (Ji *et al.*, 1995; Gong *et al.*, 1995). Tobacco consumption in China has

¹Division of Cancer Epidemiology and Genetics, National Cancer Institute, 6120 Executive Blvd., EPS 8120, Bethesda, MD 20852, USA.

²Department of Epidemiology, Shanghai Cancer Institute, People's Republic of China. ³International Epidemiology Institute, Rockville, MD, USA. Correspondence to: B-T Ji. Fax: (+1) 301 402 0081. E-Mail: jib@exchange.nih.gov

increased sharply since the late 1970s, but age at starting smoking is older and the amount of daily consumption is less than that among USA men (Yu *et al.*, 1990). The average daily intake of alcohol in Shanghai (47 g/day), however, tends to be higher than that among USA men (Liao *et al.*, 2000).

Materials and methods

This study was part of a population-based case-control study of several gastrointestinal cancers in Shanghai (pancreas, oesophagus, colon and rectum). A description of the study design has been reported in detail elsewhere (Ji *et al.*, 1995). Cases included in the present study were permanent Shanghai residents newly diagnosed with cancers of the colon (the 9th International Classification of Diseases (ICD9) 153.0–153.9) or rectum (ICD9 154.0–154.9) (World Health Organization, 1977) at ages 30–74 years between October 1990 and July 1992. All cases were identified through a rapid reporting system organized by the Shanghai Cancer Registry. Deceased cases were excluded from the study to ensure quality of interview. We had quite a low proportion of proxy interview (10% among controls and 24% among cases) due to old age and severe disease condition.

Controls were randomly selected from the general Shanghai population, frequency-matched to the expected age (± 5 years) and sex distributions of the combined series of patients diagnosed with the four gastrointestinal cancers being investigated. Personal identification cards filed in the Shanghai Resident Registry were used to select controls. The cards contain information on name, address, gender, date of birth and other demographic factors. Two random numbers (a 4-digit number for locating a drawer and a 3-digit number for locating a personal identification card within the drawer) were generated to select each control from 4410 drawers. For each control chosen, an alternate was selected. If the original control could not be interviewed, the alternate was enrolled.

Each subject was interviewed in person by trained interviewers using a standardized questionnaire to elicit information on demographic characteristics, consumption of cigarettes, alcohol and tea, dietary practices, height and weight, physical activity, medical and family cancer histories, female menstrual and reproductive histories, and lifetime occupational history. A cigarette smoker was defined as one who smoked at least one cigarette per day for 6 months or longer, and an alcohol drinker as with at least one drink per week for 6 months or longer. Ethanol

consumption was generated from the intake of beer, wine (fruit and rice wines), and hard liquor based on estimated alcohol concentrations of 4% for beer, 15% for wine and 50% for hard liquor (Chinese Academy of Medical Sciences, 1991).

Statistical analyses were conducted using logistic regression models for evaluation of multivariate relationships. Odds ratios (ORs) and 95% confidence intervals (CIs) were computed (Breslow and Day, 1980). Continuous variables of consumption of tobacco (pack-years) and alcohol were categorized by quartile based on the distribution among controls. Dose-response relationships for these categorical variables were examined. Since the prevalence of smoking and alcohol drinking differs substantially between Chinese men and women, sex-specific analyses were conducted. Risk for colon cancer was further examined by anatomic subsites of proximal (caecum, appendix, ascending colon, hepatic flexure, transverse colon and splenic flexure) and distal (descending colon and sigmoid colon) colon among men. All ORs were adjusted for age (30–49, 50–59, 60–64, 65–69 and 70–74 years) and monthly family per capita income (<30, 30–49, 50+ yuan/month). Other potential confounding variables, including years of education (0–6, 7–12 and 13+ years), diet (red meat, fruit, vegetables, fibre, vitamins C and E), body mass index and history of colorectal polyps, and proxy interview were also examined. These variables were not included in the final models because they did not materially alter the associations with tobacco and alcohol.

Results

Of 1011 eligible patients with colon cancer and 958 with rectal cancer, 931 patients with colon cancer (462 men, 469 women) and 874 with rectal cancer (463 men, 411 women) were successfully interviewed, yielding response rates of 92% and 91%, respectively. The main reason for non-response was death (59 colon, 36 rectum), followed by address change (14 colon, 9 rectum) and refusal (7 colon, 6 rectum). Thirty-three cases with anal cancer were not included in the analyses. All cases were documented by either pathology (95% colon, 98% rectum) or other methods including surgical examination, CT scan/ultrasound and X-ray. A total of 1552 controls were interviewed, including 16% alternates.

Table 1 shows the demographic characteristics of cases and controls. Among men, the age of patients with colon and rectal cancer was similar to that of

Table 1. Demographic characteristics of colon and rectal cancer cases and population controls, Shanghai, 1990–1992

	Men			Women		
	Control <i>N</i> (%)	Colon <i>N</i> (%)	Rectum <i>N</i> (%)	Control <i>N</i> (%)	Colon <i>N</i> (%)	Rectum <i>N</i> (%)
Total number of subjects	851	462	463	701	469	411
Age (years)						
Median	62	62	62	61	62	60
30–49	130 (15.3)	75 (16.2)	94 (20.3)	108 (15.4)	90 (19.2)	90 (21.9)
50–59	182 (21.4)	95 (20.6)	90 (19.4)	194 (27.7)	94 (20.0)	100 (24.3)
60–64	195 (22.9)	108 (23.4)	102 (22.0)	147 (21.0)	105 (22.4)	96 (23.4)
65–69	183 (21.5)	100 (21.6)	101 (21.8)	136 (19.4)	97 (20.7)	73 (17.8)
70–74	161 (18.9)	84 (18.2)	76 (16.4)	116 (16.5)	83 (17.7)	52 (12.6)
Income (yuan/month)						
<30	250 (29.5)	99 (21.5)	110 (23.8)	251 (36.1)	118 (25.2)	104 (25.4)
30–49	303 (35.8)	159 (34.5)	155 (33.5)	242 (34.8)	161 (34.4)	130 (31.8)
50+	294 (34.7)	203 (44.0)	198 (42.7)	203 (29.2)	189 (40.4)	175 (42.8)
School (years)						
0–6	313 (37.5)	144 (31.6)	167 (36.4)	399 (57.8)	260 (56.9)	239 (58.4)
7–12	258 (30.9)	143 (31.4)	145 (31.6)	159 (23.0)	95 (20.8)	85 (20.8)
13+	264 (31.6)	169 (37.0)	147 (32.0)	132 (19.2)	102 (22.3)	85 (20.8)
Born in Shanghai						
Yes	359 (42.2)	203 (43.9)	190 (41.0)	305 (43.5)	202 (43.1)	182 (44.3)
No	492 (57.8)	259 (56.1)	273 (59.0)	396 (56.5)	267 (56.9)	229 (55.7)
Marital status						
Currently married	769 (90.4)	427 (92.4)	418 (90.3)	543 (77.5)	372 (79.3)	320 (77.9)
Not married	82 (9.6)	35 (7.6)	45 (9.7)	158 (22.5)	97 (20.7)	91 (22.1)

controls (median age 62 years). Among women, colon cancer cases tended to be slightly older, and rectal cancer cases younger than controls (median age for controls and for colon and rectal cancer cases was 61, 62, and 60 years, respectively). Cases had higher family per capita income than controls, whereas no significant differences were observed for place of birth (Shanghai versus other), marital status or education among cases than controls.

After adjustment for age, income and alcohol consumption (men only), risks of colon cancer related to current smoking were less than unity among men (OR 0.8, 95% CI 0.6–1.0) and women (OR 0.6, 95% CI 0.4–1.0) (Table 2). Generally, no trend in risk was observed with number of cigarettes smoked per day, age started, duration, and pack-years of smoking in either sex. The risks were similar for proximal and distal colon cancers (data not shown). For rectal cancer, risks were not linked overall to current cigarette smoking among men (OR 0.9, 95% CI 0.7–1.2) or women (OR 0.9, 95% CI 0.5–1.3), but a 50% elevated risk of borderline significance was seen among men who were long-term and heavy smokers (55+ pack-years). Moreover, men and women who smoked 30 or more cigarettes per day had a 30–60% excess risk of rectal cancer, while smokers of 40 or more years had a 20–30% excess risk (Table 2). Among former and current smokers, there were no differences in the risks of colorectal cancer according

to the amount and duration of smoking (data not shown).

Overall, the risks of colon and rectal cancers were elevated among former alcohol drinkers, but not among current drinkers after adjustment for age, income and cigarette smoking (Table 3). Among current drinkers, however, increased risks were associated with long-term or heavy consumption. The ORs for colon cancer among men were 1.3 (95% CI 0.9–1.8) and 1.4 (95% CI 0.9–2.2) for current drinkers of 30–44 years and 45+ years, respectively. In addition, risks were elevated among those in the highest quartile of weekly ethanol intake (OR 1.5, 95% CI 1.1–2.2), and those in the third (OR 1.4, 95% CI 1.0–2.1) and highest (OR 1.3, 95% CI 0.9–2.0) quartile of lifetime intake. For rectal cancer, the excess risks among men with the highest level of drinking duration (OR 1.3, 95% CI 0.7–2.1) or weekly ethanol intake (OR 1.2, 95% CI 0.8–1.7) were not statistically significant. Further analyses did not reveal any appreciable differences in risk for proximal and distal colon cancers among men (data not shown). Among women, the number of alcohol drinkers was too small for meaningful analyses, although risks tended to be elevated among heavy and long-term drinkers (Table 3).

Further analyses revealed that increased risks appeared to be restricted to drinkers of hard liquor. Among men with the highest lifetime intake of hard

Table 2. Odds ratios^a (ORs) and 95% confidence intervals (CIs) for colorectal cancer in relation to cigarette smoking, Shanghai

	Men				Women					
	Controls	Colon cancer		Rectal cancer		Controls	Colon cancer		Rectal cancer	
		Cases	OR (95% CI)	Cases	OR (95% CI)		Cases	OR (95% CI)	Cases	OR (95% CI)
Smoking status										
Non-smokers	289	176	1.0	158	1.0	613	429	1.0	364	1.0
Ex-smokers	113	69	0.9 (0.6–1.3)	66	1.1 (0.7–1.6)	17	8	0.6 (0.3–1.5)	13	1.4 (0.7–3.0)
Current smokers	449	217	0.8 (0.6–1.0)	239	0.9 (0.7–1.2)	71	32	0.6 (0.4–1.0)	34	0.9 (0.5–1.3)
Cigarettes smoked per day										
1–9	105	43	0.7 (0.4–1.0)	49	0.8 (0.6–1.3)	44	13	0.4 (0.2–0.8)	20	0.8 (0.5–1.4)
10–19	164	96	0.9 (0.7–1.3)	84	0.9 (0.6–1.3)	29	15	0.8 (0.4–1.5)	13	0.9 (0.4–1.7)
20–29	239	117	0.8 (0.6–1.1)	130	0.9 (0.7–1.3)	20 ⁺ ^b	12	1.1 (0.5–2.5)	14	1.6 (0.8–3.5)
30+	54	30	0.8 (0.5–1.3)	42	1.3 (0.8–2.1)	15		0.28		0.65
(P for trend)			0.17		0.68					
Age started smoking										
<20	145	74	0.8 (0.5–1.1)	81	0.9 (0.7–1.3)	<25 ^b	13	0.9 (0.4–1.9)	16	1.4 (0.7–2.9)
20–29	276	143	0.8 (0.6–1.1)	165	1.0 (0.8–1.4)	20	27	0.6 (0.3–0.9)	31	0.8 (0.5–1.3)
30+	141	69	0.8 (0.6–1.1)	59	0.8 (0.5–1.1)	25 ⁺ ^b		0.02		
(P for trend)			0.17		0.44		68			0.58
Duration (years)										
0.5–19	123	49	0.6 (0.4–0.9)	49	0.5 (0.3–0.8)	23	12	0.7 (0.4–1.5)	11	0.8 (0.4–1.7)
20–29	106	62	0.8 (0.6–1.2)	59	0.8 (0.6–1.2)	19	5	0.4 (0.1–1.0)	11	1.0 (0.5–2.2)
30–39	134	66	0.8 (0.6–1.2)	76	1.1 (0.8–1.6)	24	8	0.5 (0.2–1.1)	10	0.8 (0.4–1.7)
40+	199	109	0.9 (0.6–1.3)		1.2 (0.9–1.7)	22	15	0.9 (0.5–1.9)	15	1.3 (0.6–2.6)
(P for trend)			0.44	121	0.17			0.13		0.63
Pack-years										
<15	177	90	0.8 (0.6–1.2)	81	0.7 (0.5–1.1)	<10 ^b	16	0.5 (0.3–0.9)	19	0.7 (0.4–1.3)
15–34	206	94	0.7 (0.5–1.0)	102	0.9 (0.6–1.2)	45	24	0.8 (0.5–1.4)	28	1.2 (0.7–2.0)
35–54	136	82	1.0 (0.7–1.4)	86	1.2 (0.8–1.7)	10+				
55+	43	20	0.6 (0.4–1.2)	36	1.5 (0.9–2.5)	43				
(P for trend)			0.19		0.17			0.10		0.78

^aAdjusted for age, income, and alcohol consumption (men only).

^bSpecific exposure levels for women.

liquor (20 kg/week-years), ORs were 1.9 for proximal colon cancer (95% CI 1.1–3.1), 1.7 for distal colon cancer (95% CI 1.0–2.9), and 1.2 for rectal cancer (95% CI 0.8–1.9) (Table 4). However, dose–response relationships were not statistically significant. The risks were not altered by adjusting for other alcohol beverages, including beer, yellow wine and sweet wine, none of which were related to colon or rectal cancers (data not shown).

In our study, about 60% of male controls both smoked cigarettes and drank alcohol. Although no statistically significant interaction was seen between smoking and alcohol drinking, there was a nearly threefold increased risk of colon (OR 2.8, 95% CI 1.0–7.5) and rectal (OR 3.0, 95% CI 1.1–8.0) cancers among heavy smokers (30+ cigarettes smoked per day) with the highest quartile of weekly ethanol intake (data not shown).

Discussion

In our case–control study of colorectal cancer in Shanghai, neither cigarette smoking nor alcohol

drinking emerged as a strong risk factor. Although heavy and long-term smokers had a slight excess of rectal cancer, the risk was not statistically significant and no dose–response relationships were observed. A few previous prospective cohort and case–control studies have observed a significant association between cigarette smoking and colorectal cancer (Giovannucci *et al.*, 1994a,b; Heinenman *et al.*, 1995; Slattery *et al.*, 1997; Hsing *et al.*, 1998; Stürmer *et al.*, 2000; Terry *et al.* 2001), but a number of other studies have not (Potter *et al.*, 1993; Schottenfeld and Winawer, 1996), including several recent epidemiological studies in Europe (D’Avanzo *et al.*, 1995; Nyrén *et al.*, 1996; Tavani *et al.*, 1998b).

Given the well-established association between cigarette smoking and adenomatous polyps of the colon and rectum (Zahm *et al.*, 1991; Giovannucci and Martínez, 1996; Longnecker *et al.*, 1996), it appears paradoxical that the relation to smoking has been inconsistently observed in colorectal cancer. To reconcile these findings, Giovannucci and Martínez (1996) hypothesized that smoking is an initiator of colorectal cancer, which requires several decades of induction (30–40 years). Some studies have found

Table 3. Odds ratios^a (ORs) and 95% confidence intervals (CIs) for colorectal cancer in relation to alcohol use, Shanghai

	Men				Women					
	Controls	Colon cancer		Rectal cancer		Controls	Colon cancer		Rectal cancer	
		Cases	OR (95% CI)	Cases	OR (95% CI)		Cases	OR (95% CI)	Cases	OR (95% CI)
Drinking status										
Non-drinkers	462	248	1.0	255	1.0	659	448	1.0	390	1.0
Ex-drinkers	37	41	2.3 (1.4–3.7)	34	1.1 (0.9–1.4)	7	6	1.4 (0.4–4.3)	4	1.2 (0.7–2.3)
Current drinkers	352	173	1.0 (0.8–1.3)	174	0.6 (0.4–1.0)	35	15	0.7 (0.4–1.3)	17	1.1 (0.3–4.1)
Years of drinking ^b										
<15	90	33	0.7 (0.5–1.1)	35	0.7 (0.4–1.0)	15	7	0.8 (0.3–2.0)	6	0.7 (0.3–1.9)
15–30	91	39	0.8 (0.5–1.2)	43	0.8 (0.5–1.2)	11	2	0.3 (0.1–1.3)	2	0.2 (0.1–1.2)
30–44	106	61	1.3 (0.9–1.8)	55	1.0 (0.7–1.5)	5	3	1.0 (0.2–4.9)	7	2.3 (0.7–7.5)
45+	65	40	1.4 (0.9–2.2)	41	1.3 (0.7–2.1)	4	3	1.1 (0.2–5.4)	2	0.9 (0.1–5.1)
(<i>P</i> for trend)			0.10		0.50			0.50		1.0
Weekly ethanol intake (Quartile) ^{bc}										
Q1 (low)	88	36	0.8 (0.5–1.2)	29	0.6 (0.4–0.9)	9	2	0.3 (0.1–1.5)	1	0.2 (0.02–1.5)
Q2	88	32	0.8 (0.5–1.2)	40	0.9 (0.6–1.3)	9	6	1.0 (0.4–3.0)	5	0.8 (0.3–2.7)
Q3	89	40	0.9 (0.6–1.4)	46	1.0 (0.6–1.5)	10	1	0.2 (0.03–1.6)	5	0.9 (0.3–2.8)
Q4 (high)	87	65	1.5 (1.1–2.2)	58	1.2 (0.8–1.7)	7	6	1.4 (0.4–4.6)	6	1.4 (0.5–4.5)
(<i>P</i> for trend)			0.16		0.60			0.60		0.9
Lifetime ethanol intake (Quartile) ^{bd}										
Q1 (low)	90	33	0.7 (0.5–1.1)	33	0.6 (0.4–1.0)	10	5	0.8 (0.3–2.6)	5	0.9 (0.3–2.7)
Q2	86	28	0.7 (0.4–1.1)	38	0.8 (0.5–1.2)	8	1	0.1 (0.02–1.2)	0	0
Q3	88	60	1.4 (1.0–2.1)	50	1.1 (0.7–1.6)	9	5	1.1 (0.3–3.3)	4	0.7 (0.2–2.5)
Q4 (high)	88	52	1.3 (0.9–2.0)	52	1.1 (0.8–1.7)	8	4	0.8 (0.2–3.0)	8	1.8 (0.6–5.0)
(<i>P</i> for trend)			0.16		0.70			0.40		0.8

^aAdjusted for age, income, and cigarette smoking.^bAmong current drinkers.^cEthanol consumption was generated from the intake of beer (4%), yellow wine (15%), sweet wine (15%) and hard liquor (50%). The cut-off points for the quartile were Q1: ≤159 g, Q2: >159–≤329 g, Q3: >329–<560 g and Q4: ≥560 g for men; and Q1: ≤45 g, Q2: >45–≤115 g, Q3: >115–<262.5 g, Q4: ≥262.5 g for women.^dLifetime intake was computed as ethanol weekly average multiplied by years of drinking (year-grams/week). The cut-off points for the quartile were Q1: ≤2040, Q2: >2040–≤5679, Q3: >5679–<13 361, and Q4: ≥13 361 for men; and Q1: ≤522, Q2: >522–≤800, Q3: >800–<4900, Q4: ≥4900 for women.

Table 4. Odds ratios^a (ORs) and 95% confidence interval (CIs) for cancers of the proximal and distal colon and rectum in relation to consumption of hard liquor among men, Shanghai

	Controls	Proximal colon cancer		Distal colon cancer		Rectal cancer	
		Cases	OR (95% CI)	Cases	OR (95% CI)	Cases	OR (95% CI)
Non-drinkers	462	127	1.0		1.0	255	1.0
Non-liquor drinkers	134	25	0.7 (0.4–1.1)	24	0.8 (0.5–1.3)	63	0.9 (0.6–1.2)
Ever hard liquor drinkers							
1–99 year-liang/week ^b	59	11	0.8 (0.4–1.5)	12	0.9 (0.5–1.8)	27	0.8 (0.6–1.2)
100–399 year-liang/week	86	22	1.1 (0.7–1.9)	20	1.2 (0.7–2.0)	35	0.8 (0.5–1.3)
400+ year-liang/week	73	30	1.9 (1.1–3.1)	24	1.7 (1.0–2.9)	49	1.2 (0.8–1.9)
(<i>P</i> for trend)			0.06		0.13		0.9

^aAdjusted for age, income and cigarette smoking.^b1 liang = 50 g.

elevated risks primarily among long-term heavy smokers (Giovannucci *et al.*, 1994a,b; Heinenman *et al.*, 1995; Newcomb *et al.*, 1995; Knekt *et al.*, 1998; Terry *et al.*, 2001), whereas others found no association with years of smoking or age first started smoking (Doll *et al.*, 1994; D'Avanzo *et al.*, 1995; Nyrén *et al.*, 1996; Tavani *et al.*, 1998b). Smoking appears not to be a risk factor in the present study, but further observation may be needed. Residents of Shanghai tended to start smoking at a later age (mean 25 years), and smoked on average for a shorter duration (mean 32 years) and lower number of cigarettes per day (16 cigarettes/day) than populations in the USA and Europe (Yu *et al.*, 1990; Yuan *et al.*, 1996; Terry *et al.*, 2001). There were also few long-term smokers who smoked heavily. Among smokers of 40+ years, the average number of cigarettes smoked per day was 17.6, which was slightly more than the average number consumed by smokers of shorter duration.

In our study, heavy alcohol drinking increased the risk for colon cancer, although the dose–response relationship was weak. The collective epidemiological evidence relating alcohol consumption to colorectal cancer is not consistent (Potter *et al.*, 1993). A meta-analysis based on 27 case–control and cohort studies revealed a 10% excess risk of colorectal cancer among those who had two or more alcoholic drinks daily compared with non-drinkers (Longnecker *et al.*, 1990). Subsequently, a number of US and European studies reported 50% to twofold or higher risk of colorectal cancer and adenomas among moderate or heavy alcohol drinkers (Meyer and White, 1993; Giovannucci *et al.*, 1993, 1995; Newcomb *et al.*, 1995; Hsing *et al.*, 1998), but several other studies have found no association for either colon or rectal cancer (Adami *et al.*, 1992; Tavani *et al.*, 1998a) or adenomas (Todoroki *et al.*, 1995; Nagata *et al.*, 1999). The fact that risk of alcohol drinking was

somewhat higher among former than current users cannot rule out the effect of the change of consuming pattern due to the disease, and we did not find former drinkers drank more heavily than current drinkers.

Specific forms of alcohol have been suggested as risk factors for colorectal cancer. Consumption of beer, one of the most common alcoholic beverages in the US and Europe, has been linked most often to excess risk (Kune and Vitetta, 1992; Goldbohm *et al.*, 1994; Hsing *et al.*, 1998), perhaps due to contamination with nitrosamines (Goldbohm *et al.*, 1994), but some studies have suggested a greater influence of wine and/or spirits (Peters *et al.*, 1992; Meyer and White, 1993; Glynn *et al.*, 1996; Tavani *et al.*, 1998a). Our study revealed no association with beer or wine, but a significantly elevated risk of colon cancer risk was noted among heavy drinkers of hard liquor, the most common form of alcoholic drink among Chinese men. A number of potential carcinogenic mechanisms have been suggested, including nutritional and metabolic alterations (e.g. folate and methionine deficiencies) associated with heavy alcohol intake (Kune and Vitetta, 1992; Giovannucci *et al.*, 1993; Wu and Henderson, 1995).

Some limitations of our case–control study should be addressed. Recall bias is a major concern, especially since reporting of cigarette and alcohol consumption by cancer patients might be influenced by recent patterns of use, so that exposure levels prior to onset of cancer may be underestimated, thus attenuating the risk estimates. The risk estimates also may be reduced by comparison to general population controls who may have colorectal adenomas. In addition, there was insufficient statistical power to estimate risks of tobacco and alcohol use among women because of their low prevalence of smoking and drinking.

In summary, this large population-based case–control study in Shanghai revealed that neither

tobacco nor alcohol use is a major risk factor for colorectal cancer. However, among men, a weak association was found between heavy smoking and risk of rectal cancer, while heavy alcohol drinking was linked to risk of colon cancer. Although tobacco smoking is unlikely to have contributed to the current rapid increases in colorectal cancer incidence in Shanghai, further studies of its role in colorectal cancer development may be warranted given the recent increases in prevalence and intensity of smoking in China.

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