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Alcohol drinking and overall and cause-specific mortality in China: nationally representative prospective study of 220 000 men with 15 years of follow-up

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Background Regular alcohol drinking contributes both favourably and adversely to health in the Western populations, but its effects on overall and cause-specific mortality in China are still poorly understood.

Methods A nationally representative prospective cohort study included 220 000 men aged 40–79 years from 45 areas in China in 1990–91, and >40 000 deaths occurred during 15 years of follow-up. Cox regression was used to relate alcohol drinking to overall and cause-specific mortality, adjusting for age, area, smoking and education.

Results Overall, 33% of the participants reported drinking alcohol regularly at baseline, consuming mainly distilled spirits, with an estimated mean amount consumed of 372 g/week (46.5 units per week). After excluding all men with prior disease at baseline and the first 3 years of follow-up, there was a 5% [95% confidence interval (CI) 2–8] excess risk of overall mortality among regular drinkers. Compared with non-drinkers, the adjusted hazard ratios among men who drank <140, 140–279, 280–419, 420–699 and $\geqslant$700 g/week were 0.97, 1.00, 1.02, 1.12 and 1.27, respectively ($P < 0.0001$ for trend). The strength of the relationship appeared to be greater in smokers than in non-smokers. There was a strong positive association of alcohol drinking with mortality from stroke, oesophageal cancer, liver cirrhosis or accidental causes, a weak J-shaped association with mortality from ischaemic heart disease, stomach cancer and lung cancer and no apparent relationship with respiratory disease mortality.

Conclusion Among Chinese men aged 40–79 years, regular alcohol drinking was associated with a small but definite excess risk of overall mortality, especially among smokers.

Keywords Alcohol, mortality, CVD, cancer, respiratory disease, prospective study, China

Introduction

Alcohol is a commonly used beverage in many populations and contributes both favourably and adversely to disease mortality and morbidity. Studies in the Western populations have shown that light-to-moderate alcohol consumption is associated with decreased mortality from cardiovascular diseases (CVD)[1–6] and certain types of cancer (e.g. thyroid cancer and renal cell carcinoma).[7,8] On the other hand, alcohol drinking can increase the risks of liver cirrhosis, accidents and many other types of cancer (e.g. oral cavity, pharynx, oesophagus, larynx, liver and female breast cancer).[7]

Although the association of alcohol drinking with particular diseases may be generalizable from one population to the other, the effect on overall mortality may not be, because of different mixtures of specific diseases. Moreover, even for a specific disease, the effect may also differ somewhat between different populations, depending on the types of alcohol used, the style of drinking and background exposure to other risk factors.[6,9,10]

Alcohol has been used widely in China for centuries. Over the past three decades, there has been a >4-fold increase in per capita alcohol consumption as a result of rapid economic development and changes in lifestyle.[11] Despite this recent increase, alcohol drinking remains predominately a male phenomenon, and the main type of alcoholic beverage used in China is distilled spirits,[11] which differs importantly from that in most Western populations. Several prospective studies have investigated the effects of alcohol in Chinese[12–18] but each has its limitations such as insufficient numbers,[14,18] being confined to a single city[15–17] or outcome monitoring limited to a few diseases. Consequently, there is still substantial uncertainty about the effects of alcohol drinking on mortality in Chinese adults. We report here a nationally representative prospective study of alcohol and mortality among 220 000 middle-aged men in China, with over 40 000 deaths during 15 years of follow-up.

Materials and Methods

Detailed information about study design, survey methods and participants has been published previously.[19,20] Briefly, the original study cohort included 225 721 men recruited from 45 areas (23 urban and 22 rural) randomly selected from China's national Disease Surveillance Points (DSPs), which was established in 145 areas to provide a nationally representative sample of mortality statistics for the entire country.[21] A typical DSP area covers 50 000–100 000 residents in four to eight geographically defined administrative units.[22] During 1990–91, all men aged >40 years from two to three randomly selected units within each of 45 areas were invited to participate in a survey. About 80% of the invitees attended the survey clinics and were interviewed by trained health workers. A standardized questionnaire was used to collect information on education, occupation, tobacco, dietary patterns, exposure to indoor air pollution and self-reported health status (good, fair and poor) and prior diseases that were diagnosed by doctors [including any cancer, stroke, heart disease, chronic obstructive pulmonary disease (COPD), asthma, tuberculosis (TB), peptic ulcer, diabetes, hypertension, kidney disease, cirrhosis and chronic hepatitis]. Physical measurements included blood pressure, height, weight and peak expiratory flow rate. The information on alcohol drinking included whether the participant had drunk alcohol regularly (i.e. drank at least once a week on a regular basis) during the past 12 months, and if so, the age at which drinking began, the type (beer, wine or spirits) and the amount of each type consumed on a typical drinking week. The total amount consumed was calculated as grams (g) of pure alcohol, based on the beverage type and amount drunk, assuming the following alcohol content by volume (v/v): beer 4%, rice wine 15% and spirits 53%.

The vital status of participants was monitored regularly by DSP staff, with additional active confirmation obtained annually.[22] Causes of death were sought chiefly from official death certificates. The underlying cause of death was coded centrally by the DSP staff in Beijing, using the ninth revision of the International Classification of Diseases-9. In the few deaths without any recent medical attention, standard procedures were used to determine the probable cause from symptoms described by family members.[22]

The present report is based on follow-up to 1 January 2006 among 218 189 men who were aged 40–79 years at baseline and had complete information on alcohol drinking. Because it is often difficult to reliably assign an underlying cause of death at older ages, all analyses were restricted to deaths occurring at ages 40–79 years, with censoring when men reached 80 years of age (or moved away from study areas). Cox proportional hazards models were used to calculate hazard ratios (HRs). All analyses were stratified by individual area and 5-year age group, and adjusted simultaneously for smoking and education. The 95% confidence interval (CI) for each log HR was estimated using the 'floating absolute risk' method,[23] which was done by adding ±1.96 times the floated standard error of the log risk to each log HR. This method facilitates different comparisons and tests for trend between different categories, rather than just pair-wise comparisons between one arbitrarily chosen reference group and other categories. Trend tests used the mean value for each alcohol consumption category as a continuous variable. The analyses were done in SAS version 9.2.

Results

Of the 218 189 participants, 33% described themselves as regular alcohol drinkers. Among regular drinkers, the estimated mean amount consumed was 372 g/week (i.e. 46.5 units/week), higher in rural than in urban men (408 vs 276 g/week). Compared with non-drinkers, regular drinkers were slightly younger, more likely to smoke and to drink tea, had higher blood pressure and were less likely to report pre-existing diseases and poor health status (Table 1). Among regular drinkers, those who drank more were more likely to live in rural areas, were less well educated, smoked more and had higher blood pressure and longer duration of alcohol drinking (Table 1). Of the regular drinkers, 93% reported drinking strong spirits only (97% in rural and 83% in urban), with the remainder drinking beer, rice wine or mixed types of beverage.

During ~15 years of follow-up, 40 925 men died before 80 years of age, including 14 347 (35.1%) deaths from CVD, 9162 (22.4%) from cancer, 10 100 (24.7%) from respiratory disease and 7316 (17.9%) from other causes. A further 34 165 men (~1% per annum) were lost to follow-up, mainly because of the demolition of whole neighbourhoods for redevelopment. There was no significant difference in the main baseline characteristics (e.g. age, blood pressure, body mass index and prevalence of smoking or drinking) between those who were lost to follow-up and those who were not.[19]

Total mortality had a J-shaped association with alcohol consumption both among men with any prior disease and among men without it. However, the HR between non-drinkers and light drinkers was much greater among men with prior disease (Figure 1). This extra risk among non-drinkers may well reflect disease-induced alcohol cessation. Since no separate information was available about ex-drinkers in the study, and to help limit any possible effects of reverse causality, subsequent analyses excluded all men with prior disease, as well as all deaths occurring within the first 3 years of follow-up.

Figure 2 and Table 2 show the associations of alcohol drinking with total and cause-specific mortality with these exclusions (based on 20 977 deaths). All-cause mortality showed a shallow J-shaped association with alcohol drinking, with the adjusted HRs of 0.97, 1.00, 1.02, 1.12 and 1.27 for those who drank <140, 140–279, 280–419, 420–699 and ⩾700 g/week, respectively, compared with non-drinkers ($P < 0.0001$ for trend among drinkers). Alcohol drinking was hardly related to respiratory diseases mortality but positively related to all CVD, all cancer and mortality from all other non-CVD, non-cancer and non-respiratory causes. For specific diseases, men who drank 140–280 g/week (i.e. 17.5-35.0 units/week) had the lowest risk of ischaemic heart disease (IHD) (HR 0.91, 95% CI 0.75–1.11). Stroke mortality showed a positive association with alcohol drinking, with the adjusted HRs of 0.99, 1.12, 1.14, 1.21 and 1.55, respectively, for men who drank <140, 140–279, 280–419, 420–699 and ⩾700 g/week ($P < 0.0001$ for trend among drinkers) (Table 2 and Figure 3). Alcohol drinking also had a positive association with liver cirrhosis and accidental deaths (e.g. violence, suicide and trauma), a J-shaped association with stomach cancer and lung cancer, but little association

Table 1 Baseline characteristics of participants by alcohol drinking, among men aged 40–79 years at baseline in 1990–91

Characteristics[a]	Overall	All-drinkers	Non-drinkers	Amount drunk (g/week)				
				<140	140–279	280–419	420–699	⩾700
No. of participants	218 189	72 866	145 323	14 208	19 391	18 681	10 870	9716
Amount drunk (g/week)		371.9		89.5	201.3	359.9	543.4	956.9
Year of drinking		29.1		28.0	28.5	29.4	29.9	30.6
Urban locality (%)[a]	27.3	27.5	27.2	39.3	32.9	24.4	19.4	14.1
Age (years)[a]	54.3	53.8	54.5	53.6	54.0	53.9	53.8	53.3
BMI (kg/m^2)	21.7	21.8	21.7	21.9	21.8	21.8	21.9	21.9
Systolic blood pressure (mm Hg)	124.0	124.9	123.6	123.4	124.4	125.1	125.9	126.6
Diastolic blood pressure (mm Hg)	78.7	79.2	78.5	78.6	78.8	79.3	79.8	80.4
Expiratory peak flow (l/min)	395.6	398.7	394.0	400.5	396.0	396.9	403.2	400.3
Education ⩽6 years (%)	66.9	67.3	66.6	63.8	67.4	68.3	67.5	70.8
Ever regular smoking (%)	73.3	86.5	66.7	82.4	86.5	87.9	88.3	88.5
Regular tea drinking (%)	42.2	54.9	35.8	56.2	54.0	53.7	55.2	56.9
Pre-existing disease (%)	16.0	14.9	16.6	15.6	14.0	14.2	15.2	16.8
Self-reported poor health status (%)	7.3	5.9	8.0	6.6	5.8	5.6	5.7	5.9

[a]Except for percentage of urban locality and mean age, all other variables were adjusted for individual area and age (5-year group) by direct standardization to the whole study population.

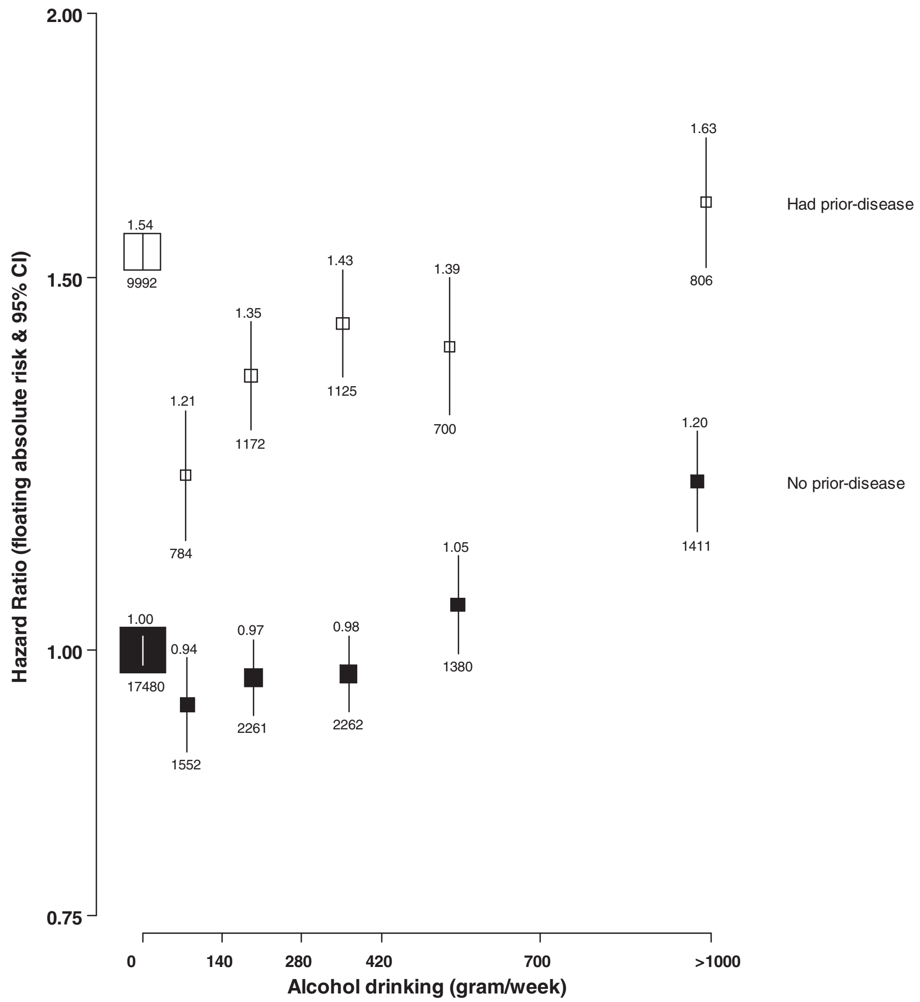

Figure 1 HRs for overall mortality vs baseline alcohol drinking among men aged 40–79 years with (61 365 men, white squares) and without (156 824 men, black squares) prior disease at baseline survey in 1990–91. Analyses were stratified by area and age, and adjusted simultaneously for education and tobacco. The HRs are plotted on a floating absolute scale. Each square has an area inversely proportional to the standard error of the log risk (SE). Vertical lines indicate the corresponding 95% confidence intervals (HR $\times$ exp $\pm$ 1.96 SE). Numbers above confidence intervals are the hazard ratios and those below confidence intervals are of deaths

with COPD. Since spirits were almost the exclusive type of alcohol used in this male population, it was not possible to examine the effects of other types of alcohol separately.

Table 3 shows HRs of total mortality by alcohol drinking subdivided by smoking status, with additional data shown in Figure 4 for other baseline variables. Among current smokers, there appeared to be a dose–response relation of amount drunk with overall mortality, with greater excess risk among heavy smokers or those who began to smoke at a younger age ($P < 0.0001$ for interaction across each and overall smoking categories). Among non-smokers, no apparent dose–response relationship was seen between alcohol drinking and overall mortality (Table 3), but this heterogeneity in effects of alcohol on total mortality by smoking status was not significant ($P = 0.07$, Figure 4). With respect to other baseline variables, the effect of alcohol drinking on overall mortality did not seem to be modified significantly by age, locality, education, blood pressure, lung function or baseline health status (Figure 4).

Discussion

This is one of the largest prospective studies of the relationship between alcohol and total and cause-specific mortality in China. In this nationally representative male population, about one-third reported drinking alcohol regularly, which involved almost exclusively strong spirits. Overall, among men who had no history of prior disease and did not die during the first 3 years of follow-up, there was a

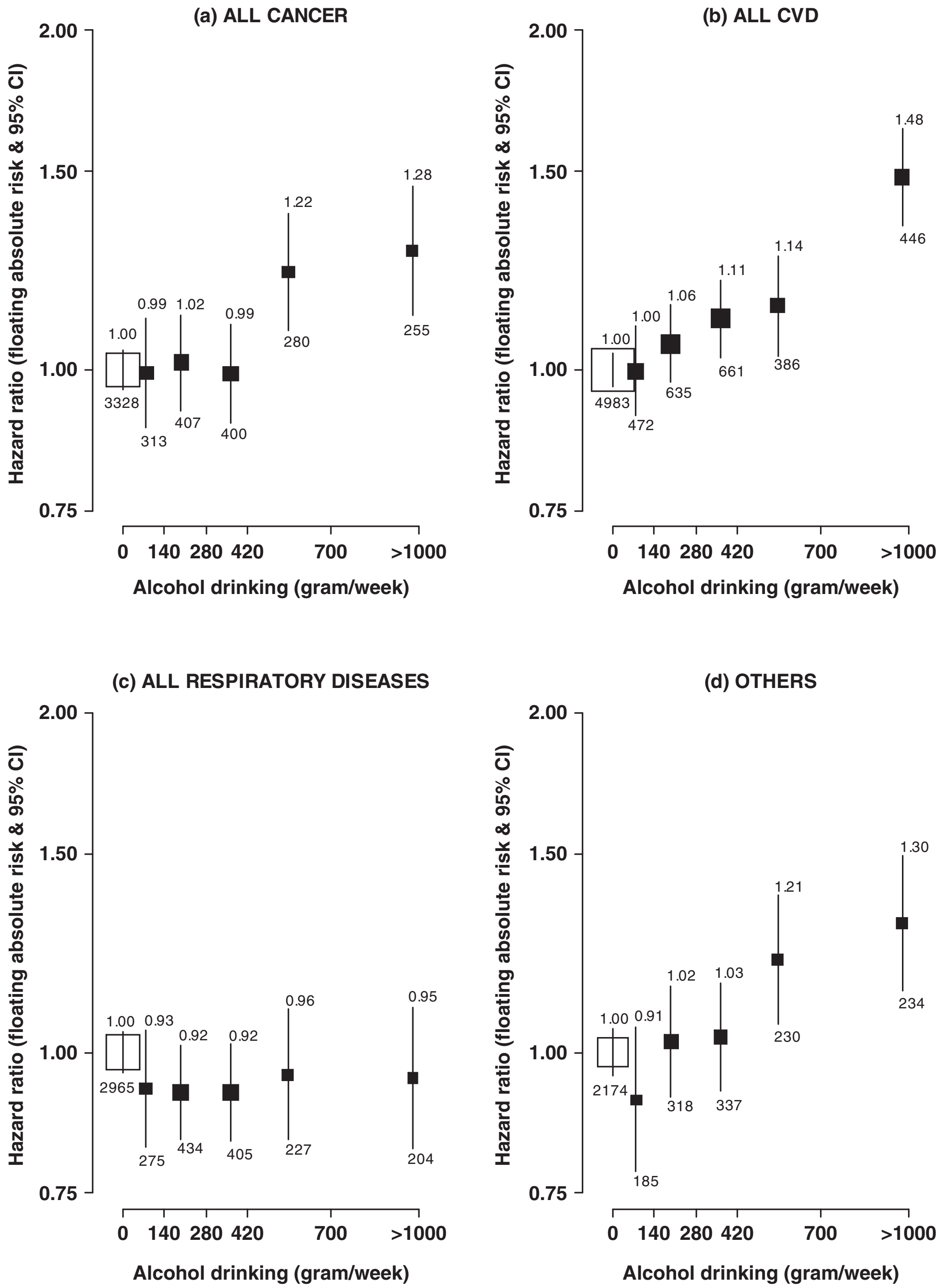

Figure 2 HRs for death from major diseases vs baseline alcohol drinking among men aged 40–79 years without prior diseases at baseline, excluding the first 3 years of follow-up. (a) All cancer, (b) all CVD, (c) all respiratory disease and (d) others. Conventions as in Figure 1, and non-drinkers (white squares) were used as the reference category

5% excess risk of total mortality among regular drinkers and the association was largely independent of age, area, education and smoking status.

Alcohol drinking and total mortality

Most previous studies in Western populations have reported a U- or J-shaped relation between alcohol consumption and total mortality.[1,2,5,6,24–26] In a cohort study of male British doctors involving 7000 deaths, the relative risks of total mortality among men who drank 1–7, 8–14, 15–28 and ⩾29 units/week were 0.79, 0.75, 0.8 and 0.93, compared with non-drinkers.[1] In a large prospective study among 490 000 US adults (including 238 000 men with 29 000 deaths), the overall death rates were lowest

Table 2 Numbers of deaths and standardized hazard ratios for cause-specific deaths by alcohol drinking, among men aged 40–79 years without prior diseases at baseline, excluding the first 3 years of follow-up

Causes of death	All-drinkers	Non-drinkers	Amount drunk (g/week)					*P*-value for trends*
			<140	140–279	280–419	420–699	⩾700	
Cardiovascular disease								
IHD								
No. of deaths	435	1002	99	101	112	57	66	
HR (95% CI)	1.08 (0.96–1.22)	1.00 (0.93–1.08)	0.99 (0.81–1.21)	0.91 (0.75–1.11)	1.17 (0.97–1.41)	1.12 (0.86–1.45)	1.60 (1.23–2.07)	<0.001
Stroke								
No. of deaths	1642	3002	274	400	422	260	286	
HR (95% CI)	1.16 (1.08–1.24)	1.00 (0.96–1.05)	0.99 (0.88–1.12)	1.12 (1.01–1.24)	1.14 (1.03–1.26)	1.21 (1.07–1.37)	1.55 (1.37–1.75)	<0.0001
Other CVD								
No. of deaths	523	979	99	134	127	69	94	
HR (95% CI)	1.03 (0.92–1.16)	1.00 (0.93–1.07)	1.02 (0.84–1.25)	1.01 (0.85–1.20)	0.99 (0.83–1.18)	0.96 (0.75–1.22)	1.26 (1.01–1.57)	<0.0001
All CVD								
No. of deaths	2600	4983	472	635	661	386	446	
HR (95% CI)	1.12 (1.06–1.18)	1.00 (0.97–1.03)	1.00 (0.91–1.09)	1.06 (0.98–1.14)	1.11 (1.03–1.20)	1.14 (1.03–1.26)	1.48 (1.34–1.64)	<0.0001
Cancer								
Liver								
No. of deaths	412	703	62	108	103	79	60	
HR (95% CI)	1.12 (0.98–1.28)	1.00 (0.91–1.09)	0.98 (0.76–1.25)	1.13 (0.94–1.37)	1.02 (0.84–1.25)	1.38 (1.11–1.73)	1.21 (0.92–1.09)	0.24
Stomach								
No. of deaths	323	814	67	82	81	47	46	
HR (95% CI)	0.96 (0.84–1.10)	1.00 (0.92–1.09)	0.87 (0.68–1.11)	0.95 (0.77–1.19)	0.96 (0.77–1.20)	1.00 (0.75–1.34)	1.15 (0.85–1.57)	0.02
Lung								
No. of deaths	404	678	60	94	105	77	68	
HR (95% CI)	1.03 (0.90–1.18)	1.00 (0.92–1.09)	0.86 (0.66–1.11)	0.92 (0.75–1.13)	1.02 (0.84–1.24)	1.30 (1.03–1.63)	1.25 (0.97–1.62)	0.04
Oesophageal								
No. of deaths	242	606	62	62	52	36	30	
HR (95% CI)	1.25 (1.07–1.47)	1.00 (0.91–1.10)	1.19 (0.93–1.53)	1.28 (1.00–1.65)	1.11 (0.84–1.46)	1.38 (0.99–1.94)	1.63 (1.12–2.39)	0.2
Colorectal								
No. of deaths	63	130	18	11	16	8	10	
HR (95% CI)	0.90 (0.65–1.24)	1.00 (0.82–1.22)	1.26 (0.79–2.02)	0.60 (0.33–1.08)	0.88 (0.53–1.45)	0.77 (0.38–1.55)	1.06 (0.55–2.06)	0.5
Other sites								

(continued)

Table 2 Continued

Causes of death	All-drinkers	Non-drinkers	Amount drunk (g/week)					*P*-value for trends*
			<140	140–279	280–419	420–699	⩾700	
No. of deaths	208	397	44	50	43	33	41	
HR (95% CI)	1.05 (0.88–1.26)	1.00 (0.89–1.12)	1.15 (0.85–1.55)	0.96 (0.72–1.27)	0.85 (0.63–1.15)	1.10 (0.77–1.56)	1.39 (1.00–1.94)	0.6
All cancers								
No. of deaths	1655	3328	313	407	400	280	255	
HR (95% CI)	1.06 (1.00–1.13)	1.00 (0.96–1.04)	0.99 (0.89–1.11)	1.01 (0.92–1.12)	0.99 (0.90–1.10)	1.22 (1.08–1.38)	1.28 (1.12–1.45)	<0.001
Respiratory disease								
COPD								
No. of deaths	1298	2589	242	386	343	175	152	
HR (95% CI)	0.92 (0.86–0.99)	1.00 (0.96–1.04)	0.93 (0.81–1.05)	0.96 (0.86–1.06)	0.94 (0.84–1.05)	0.90 (0.77–1.05)	0.86 (0.73–1.01)	0.93
TB								
No. of deaths	85	156	11	18	20	15	21	
HR (95% CI)	0.89 (0.67–1.17)	1.00 (0.84–1.19)	0.80 (0.44–1.46)	0.71 (0.45–1.14)	0.75 (0.48–1.18)	0.99 (0.59–1.65)	1.45 (0.91–2.30)	0.03
All respiratory disease								
No. of deaths	1545	2965	275	434	405	227	204	
HR (95% CI)	0.93 (0.87–0.99)	1.00 (0.96–1.04)	0.93 (0.82–1.05)	0.92 (0.84–1.01)	0.92 (0.83–1.02)	0.96 (0.84–1.09)	0.95 (0.82–1.10)	0.11
Other diseases								
Cirrhosis								
No. of deaths	163	255	27	30	44	27	35	
HR (95% CI)	1.15 (0.93–1.42)	1.00 (0.87–1.16)	1.12 (0.76–1.64)	0.84 (0.59–1.21)	1.16 (0.85–1.56)	1.22 (0.83–1.79)	1.74 (1.22–2.48)	<0.01
Violence, suicide and other trauma								
No. of deaths	543	863	68	120	155	98	102	
HR (95% CI)	1.20 (1.07–1.34)	1.00 (0.92–1.08)	0.90 (0.71–1.15)	1.10 (0.92–1.32)	1.35 (1.15–1.58)	1.36 (1.11–1.67)	1.34 (1.08–1.65)	0.04
All causes								
No. of deaths	7237	13740	1273	1838	1833	1137	1156	
Mortality rate[a]	1116	1046	1040	1589	1152	1167	4064	
HR (95% CI)	1.05 (1.02–1.08)	1.00 (0.98–1.02)	0.97 (0.91–1.02)	1.00 (0.96–1.05)	1.02 (0.97–1.07)	1.12 (1.06–1.19)	1.27 (1.19–1.35)	<0.0001

[a]Mortality rates are standardized to the geographical area and the 5-year age group structures in the study population aged 40–79 years.
*P-value for trends among alcohol drinkers.

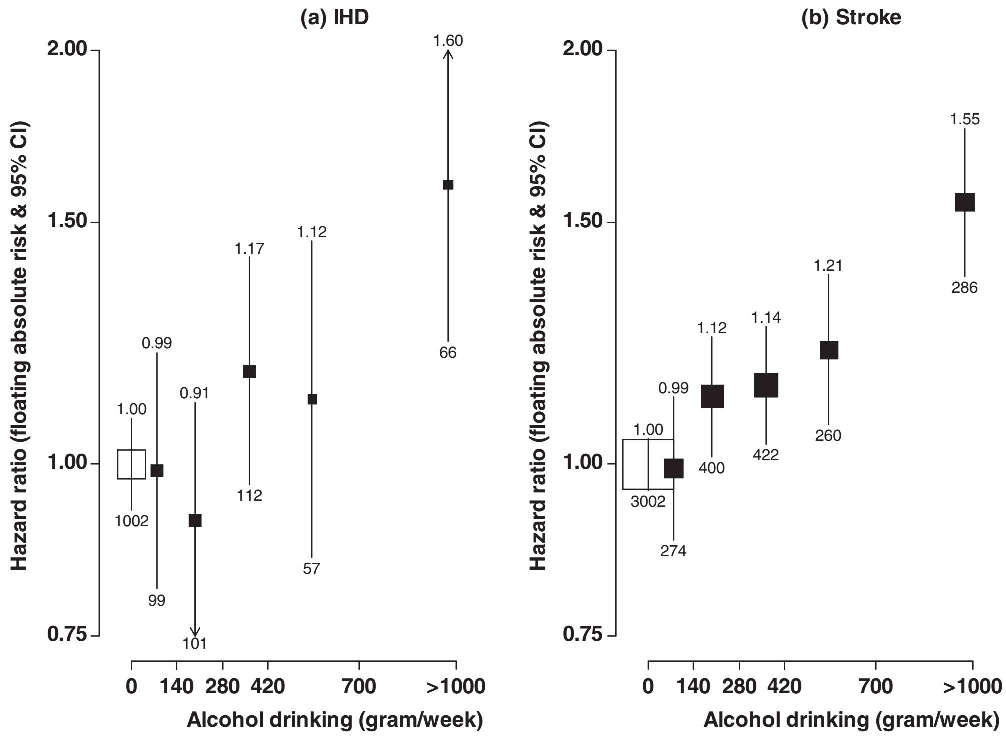

Figure 3 HRs for cause-specific mortality vs baseline alcohol drinking among men aged 40–79 years without prior diseases at baseline, excluding the first 3 years of follow-up. (a) IHD and (b) stroke. Conventions as in Figures 1 and 2

Table 3 Standardized hazard ratios for total mortality by alcohol drinking and smoking status, among men aged 40–79 years without prior diseases at baseline excluding the first 3 years of follow-up

	Non-drinker		Alcohol drinking category					
			<280 g/week		280–700 g/week		⩾700 g/week	
Smoking category	No. of deaths	HR (95% CI)[b]	No. of deaths	HR (95% CI)[b]	No. of deaths	HR (95% CI)[b]	No. of deaths	HR (95% CI)[b]
Never smokers	4132	1.00 (0.97–1.03)[a]	372	0.94 (0.85–1.04)	352	0.97 (0.87–1.08)	163	1.08 (0.92–1.27)
Ex-smokers	486	1.14 (1.04–1.25)	103	0.90 (0.74–1.10)	79	0.93 (0.74–1.16)	46	1.51 (1.12–2.02)
Current smokers	9122	1.12 (1.10–1.15)	2636	1.14 (1.09–1.18)	2539	1.21 (1.17–1.26)	947	1.46 (1.37–1.56)
Amount smoked (g/day)								
<20	4683	1.11 (1.08–1.15)	1310	1.08 (1.02–1.14)	842	1.19 (1.11–1.27)	261	1.48 (1.31–1.68)
20–30	2973	1.12 (1.08–1.16)	863	1.14 (1.06–1.22)	900	1.24 (1.16–1.32)	330	1.42 (1.27–1.58)
⩾30	1456	1.15 (1.09–1.21)	461	1.29 (1.18–1.42)	797	1.23 (1.14–1.32)	355	1.51 (1.36–1.68)
Age began smoking (years)								
⩾25	2735	1.05 (1.01–1.09)	771	1.08 (1.00–1.16)	532	1.12 (1.03–1.22)	154	1.31 (1.12–1.53)
20–25	3843	1.15 (1.11–1.19)	1138	1.14 (1.08–1.21)	1105	1.26 (1.19–1.34)	361	1.39 (1.25–1.55)
<20	2536	1.16 (1.12–1.21)	727	1.18 (1.10–1.27)	902	1.23 (1.15–1.32)	432	1.61 (1.47–1.78)

[a]Non-drinkers and never smokers were used as the reference group.
[b]HRs were adjusted for education and stratified by age and area. The 95% CI was estimated using the 'floating absolute risk' method. Participants with missing values were excluded from the analyses.

in those reporting one drink per day (i.e. <100 g/week), after which the total mortality among drinkers gradually increased.[6] Since many Asians cannot metabolize alcohol effectively, it was hypothesized that the effects of alcohol on health in Asians may differ importantly from those in Caucasians.[27] However, there does not seem to be strong supportive evidence for this from the studies in Asian populations.[16,17,28,29]

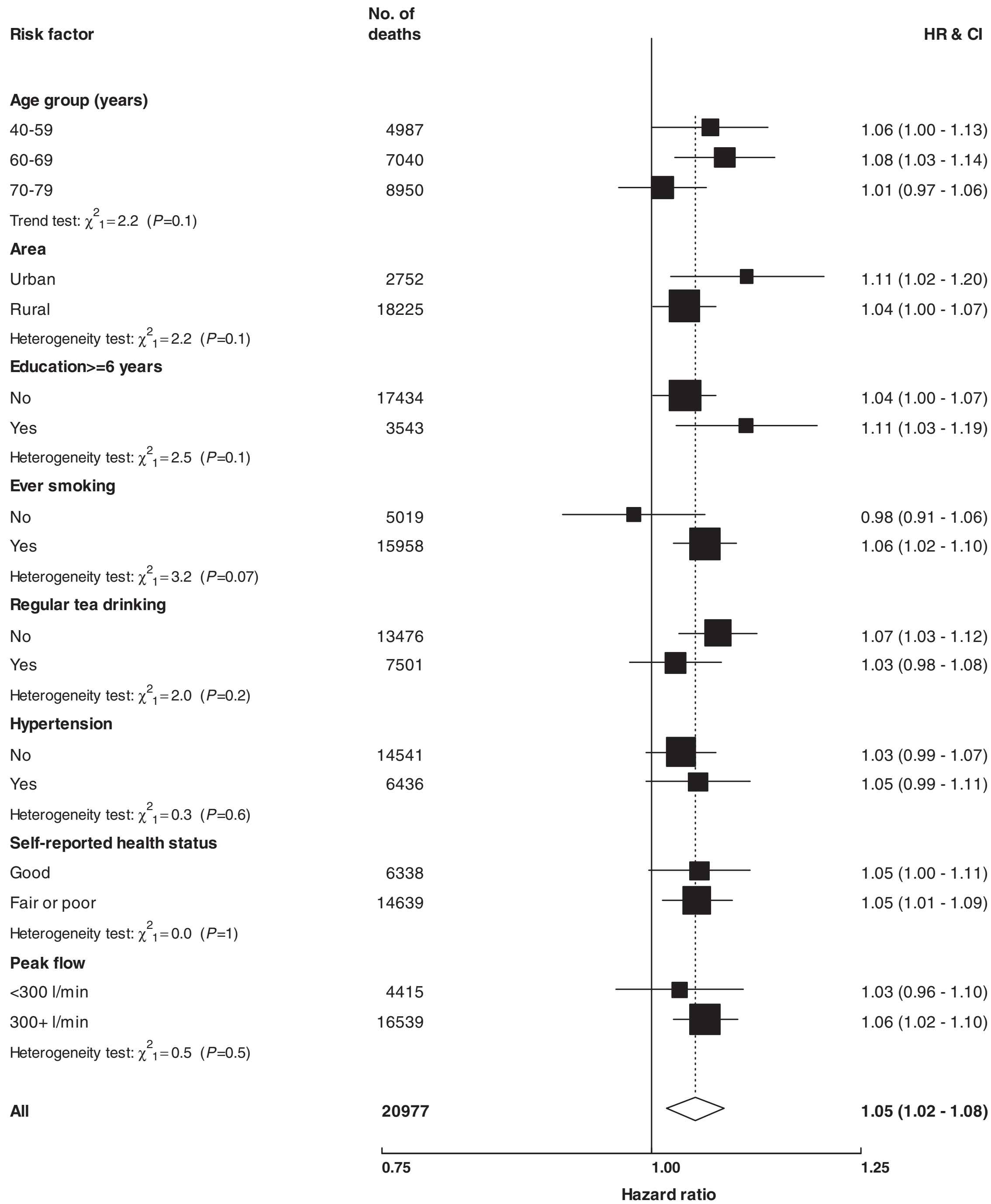

Figure 4 HR of overall mortality for regular drinkers vs non-drinkers by baseline variables among men aged 40–79 years without prior disease at baseline, excluding the first 3 years of follow-up. Each closed square represents a HR with area inversely proportional to the variance of log HR. The dotted vertical line indicates the overall HR; the open diamond indicates summary result and its 95% CI

A cohort study of 18 244 Chinese men aged 45–64 years in Shanghai, among whom 41% were current drinkers, showed that moderate drinkers had a reduced risk of total mortality (HRs: 0.80, 0.82, 0.84, 0.84, 1.03 and 1.30 for those who drank ⩽70, 80–140, 150–210, 220–280, 290–420 and ⩾420 g/week, respectively, compared with non-drinkers). The results persisted after exclusion of ex-drinkers, people with prior diseases and the first year of follow-up.[17] Similarly, in a large Japanese cohort study of 98 000 individuals (including 42 000 men, of whom 76% were current drinkers) with 10 000 deaths, current male drinkers who consumed <23 g/day of alcohol had a 20% lower risk of total mortality than non-drinkers, whereas heavier drinking (>69 g/day) was associated with a 30% increased risk.[29]

In the present study, although the size of excess risk associated with heavy drinking appeared to be generally consistent with that reported in other Asian cohort studies, the reduced risk among men who drank lightly or moderately (e.g. <280 g/week) seemed less pronounced. The reasons for the discrepancy are not entirely clear, but it may be due to a number of factors such as differences in the types of alcohol used between different study populations (e.g. 48% of alcohol use involved spirits in the Shanghai cohort vs 93% in the present study), composition of causes of death (e.g. 27% of deaths from CVD in the Japanese cohort vs 35% in our study) and completeness which reverse causality was dealt with. There is evidence from studies in the West that for a given quantity of ethanol, spirits may be associated with greater hazards for certain conditions such as cancer and IHD compared with other types of alcoholic beverage.[26] If this were also true in the Chinese population, then it could help to explain in part the lack of any apparent beneficial effects of light-to-moderate drinking on overall mortality in the present study.[17,29]

In the present study, the mean amount of alcohol consumed per drinker (372 g/week) appeared to be somewhat higher than that reported in some other studies in China,[17] and this disparity could be accounted for mainly by differences in the types of alcohol used between various parts of China and at different time periods. Indeed, when restricting analysis to urban men, the level of consumption in the present study (276 g/week) was generally compatible with that reported in other studies of similar populations (e.g. 217 g/week in the Shanghai cohort).[17] Likewise, in a recent study of over 200 000 adult men recruited from 10 diverse regions across China in 2004–08, 70% of regular drinkers reported drinking spirits (as opposed to 93% in the present study), with about one-third of them drinking weak spirits (i.e. <40% v/v) rather than the strong spirits (i.e. 53% v/v) seen in previous decades. Nevertheless, in that study the mean consumption per drinker was similar to that in the present study, being 238 g/week for urban and 333 g/week for rural men.[30] As Chinese drinkers gradually move away from strong spirits to weak spirits or other non-spirits beverages, the mean levels of consumption per drinker and the associated health effects may change as well.

Alcohol drinking and cause-specific mortality

A lower risk of CVD, especially IHD, mortality associated with light-to-moderate alcohol drinking, has been reported in many,[6,26,31] although not all,[10] cohort studies in the Western populations. A few Asian studies have also reported an inverse association between light-to-moderate alcohol drinking and IHD, whereas no such relationship was seen for stroke.[12,15–17,32] In a study of 64 000 Chinese men aged >40 years, with 976 (588 fatal) incident cases of IHD and 3434 (1848 fatal) incident strokes, alcohol drinking was associated with a reduced risk of IHD, with HRs for IHD mortality being 1.20, 0.59 and 0.53 for those who drank 1–6, 7–34 and ⩾35 drinks/week, respectively, compared with non-drinkers (the corresponding HRs for IHD incidence were 0.99, 0.67 and 0.58, respectively).[12] In contrast, heavy drinking was associated with increased risk of stroke, with HRs among participants consuming 1–6, 7–20, 21–34 and ⩾35 drinks/week being 0.93, 0.98, 1.15 and 1.30, respectively, for stroke mortality and 0.92, 1.02, 1.22 and 1.22, respectively, for stroke incidence.[13] A cohort study of 18 000 men in Shanghai with 104 IHD deaths and 269 stroke deaths also found that light-to-moderate drinking (<280 g/week) was associated with a 36% lower risk of IHD mortality, whereas for stroke, no such association was seen with light-to-moderate drinking but a significant 70% excess risk of stroke death among heavy drinkers (i.e. >280 g/week).[17] However, a cohort study in Hong Kong of 19 000 men aged >65 years with 188 IHD deaths showed that light-to-moderate alcohol use was not associated with lower risk of IHD mortality.[33] In the present cohort, although there was a slightly J-shaped association between alcohol drinking and IHD mortality, the confidence intervals were too big to draw any conclusion. For stroke, the present study with more cases than all previous Chinese studies combined provides further supportive evidence that the risk was positively associated with alcohol drinking, with heavy drinkers (⩾700 g/week) having about a 60% excess mortality.

Alcohol has been classified by the International Agency for Research on Cancer as a Group 1 carcinogen, i.e. carcinogenic to humans, with particularly strong adverse effects on cancers of the oral cavity, pharynx, larynx, oesophagus, colorectum and liver.[34,35] However, most evidence is based on studies in the Western populations, in which the main types of cancer and their underlying causes differ importantly from those in Chinese. As in a few other studies in China,[15–17] we did not find any excess risk of cancer deaths among light-to-moderate drinkers, but among heavy drinkers there was a significantly increased risk of cancer mortality, especially for oesophageal cancer. Although alcohol drinking is an independent risk factor for liver cancer in most Western populations,[35] the main cause of the high incidence of liver cancer in China is chronic infection with hepatitis B virus. In our study, there was only a weak positive association of alcohol drinking with liver cancer mortality. For liver cirrhosis, however, there was a strong positive association with alcohol drinking, confirming the finding of a few other studies in Chinese and Asian populations.[15,17] In our study, we found no apparent relationship between alcohol drinking and COPD mortality, which accounts for a large proportion of deaths. In contrast, a number of studies in Western and other Chinese populations have reported a U-shaped relationship between alcohol and COPD mortality.[15,36] These studies typically involved small numbers of COPD deaths and generally lacked proper exclusion of people with prior respiratory disease or complete adjustment for other potential confounding factors such as smoking. So, the U-shaped relationship reported in these previous studies may well be an artefact. Consistent with several other studies,[6,8,16, 17,28,29,37,38] the present study also found an interaction between smoking and alcohol drinking on overall mortality, with heavy drinkers and heavy smokers or those who began to smoke before 20 years of age having the highest overall mortality, again highlighting the complexity of disease causation and synergistic effects of multivariate exposures for common chronic diseases.

Study strengths and limitations

The present prospective study included a large sample size and a structured questionnaire, so it is unlikely that the study findings could be due to chance or recall bias. Although we have tried to control rigorously for all major confounders, residual confounding may still exist.[28] It is certain that an unknown proportion of non-drinkers were abstainers due to ill health, which could account for at least some of the excess risk in non-drinkers.[39] Although we were not able to separate ex-drinkers from non-drinkers, we have excluded from the main analyses participants with any prior diseases and the first 3 years of follow-up, thus we believe the effects of reverse causality have largely been controlled for. It has been suggested that different types of alcoholic beverage may contribute differently to disease risk, with wine drinking reportedly having more beneficial effects on IHD and certain cancers compared with other types of alcohol,[5,26,40,41] but this question cannot be examined effectively in the present study because distilled spirits were the type of alcohol that was most exclusively used. Another limitation of the study is that only information on average alcohol consumption was collected at baseline, so we could not assess the effect of different drinking patterns (such as binge drinking or drinking with meals) on mortality. As in many other prospective studies, we only assessed alcohol exposure at baseline, and it is likely that alcohol intake patterns have changed over time, leading to misclassification for some individuals, which will tend to dilute rather than augment any real association.

Summary

Globally, alcohol is responsible for ~4% of all deaths and 5% of the global burden of disease, but its real hazards could still be underestimated, especially since some health benefits associated with light-to-moderate alcohol drinking may well not be causal.[42] In the present study of adult Chinese men, regular alcohol drinking is associated with a 5% excess risk of overall mortality, with significant excess mortality among heavy drinkers from stroke, IHD, liver cirrhosis, injury and certain types of cancer. The present study does not provide direct evidence about all aspects of alcohol drinking, nor does it provide direct evidence about the effects of alcohol in women or on non-fatal morbidity. As China continues to develop economically, the prevalence of alcohol drinking is likely to continue to increase, as it has since the 1980s,[11] and there may be further changes in the types of alcohol consumed and the ways in which people drink. These, together with other changes in the population (e.g. smoking and other lifestyle factors), may importantly affect the future health effects of alcohol drinking in the population.

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Conflict of interest: None declared.

KEY MESSAGES

- Among 220 000 Chinese men aged 40–79 years in 1990–91, 33% of the participants reported drinking alcohol regularly at baseline, consuming mainly distilled spirits.
- After excluding all men with prior disease at baseline and the first 3 years of follow-up, there was a 5% (95% CI 2–8) excess risk of overall mortality among regular drinkers.
- Compared with non-drinkers, the adjusted HRs for overall mortality were 0.97, 1.00, 1.02, 1.12 and 1.27 ($P < 0.0001$ for trend) for men drinking <140, 140–279, 280–419, 420–699 and ⩾700 g/week, respectively. The strength of the relationship appeared to be greater in smokers than in non-smokers.

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