

Alcohol consumption in 0.5 million people from 10 diverse regions of China: prevalence, patterns and socio-demographic and health-related correlates

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Background Drinking alcohol has a long tradition in Chinese culture. However, data on the prevalence and patterns of alcohol consumption in China, and its main correlates, are limited.

Methods During 2004–08 the China Kadoorie Biobank recruited 512 891 men and women aged 30–79 years from 10 urban and rural areas of China. Detailed information on alcohol consumption was collected using a standardized questionnaire, and related to socio-demographic, physical and behavioural characteristics in men and women separately.

Results Overall, 76% of men and 36% of women reported drinking some alcohol during the past 12 months, with 33% of men and 2% of women drinking at least weekly; the prevalence of weekly drinking in men varied from 7% to 51% across the 10 study areas. Mean consumption was 286 g/week and was higher in those with less education. Most weekly drinkers habitually drank spirits, although this varied by area, and beer consumption was highest among younger drinkers; 37% of male weekly drinkers (12% of all men) reported weekly heavy drinking episodes, with the prevalence highest in younger men. Drinking alcohol was positively correlated with regular smoking, blood pressure and heart rate. Among male weekly drinkers, each 20 g/day alcohol consumed was associated with 2 mmHg higher systolic blood pressure. Potential indicators of problem drinking were reported by 24% of male weekly drinkers.

Conclusion The prevalence and patterns of drinking in China differ greatly by age, sex and geographical region. Alcohol consumption is associated with a number of unfavourable health behaviours and characteristics.

Keywords Alcohol, drinking, cohort study, descriptive analysis, China

Introduction

Drinking alcohol is an established part of Chinese culture, often taking place during festivals and celebrations, with toasting at banquets or during business meetings.¹ Alcohol production in China may date back several thousand years, and traditional types of alcoholic drink include fermented and distilled beverages made from rice or wheat.² Over the past few decades, China has undergone rapid economic development and urbanization, and alcohol production and availability have increased; annual adult per capita consumption rose from below 2 litres of alcohol in 1981 to 5.9 litres in 2005.^{3,4} The prevalence of alcohol dependence and several alcohol-related diseases has also increased.^{5,6}

Prospective studies, mainly in European or North American populations, have shown that alcohol consumption, especially heavy drinking, can cause liver cirrhosis, pancreatitis, pneumonia, tuberculosis, injuries, mental illness and certain types of cancer (e.g. mouth, oesophagus, liver).^{7,8} Light to moderate drinking, however, has been associated with a reduced risk of cardiovascular diseases.^{9,10} As well as amount, the patterns of drinking (e.g. heavy drinking episodes) and exposure to other risk factors may modify the health effects of alcohol.^{7,11,12} An understanding of the patterns and main correlates of alcohol consumption is therefore essential for an unbiased assessment of the health effects of alcohol use in different populations. However, there is limited large-scale evidence on drinking patterns and the correlates of alcohol use in China.^{5,8,13,14}

We report here the prevalence and patterns of alcohol consumption, and investigate the relationship between alcohol consumption and socio-demographic and health-related characteristics, among 512 891 men and women, using cross-sectional data collected during the baseline survey of the China Kadoorie Biobank.^{15,16}

Methods

Study design and participants

The study objectives and design are described elsewhere.^{15,16} In brief, 512 891 men and women aged 30–79 years (mean 52 years) were enrolled between 2004 and 2008 from 10 diverse rural and urban areas in China, selected according to local disease patterns,

exposure to certain risk factors, population stability, quality of death and disease registries, local commitment and capacity. Within each area, permanent residents without major disability in each of 100–150 administrative units (rural villages or urban residential committees) selected for the study were identified from local records and sent an invitation letter and leaflet inviting them to participate. The participation rate was 33% in rural areas and 27% in urban areas, and the main reasons for non-participation (reported anecdotally by field staff) were absence from the home and reluctance to spend a few hours visiting the screening centre.

The baseline survey was conducted in local assessment centres set up specifically for the study. Trained health workers administered a standardized questionnaire using a laptop-based direct data-entry system, with built-in functions to avoid logical errors and missing items. It included detailed questions on general demographic and socioeconomic status, medical history and health status, smoking, alcohol drinking, diet, physical activity and other lifestyle behaviours.

Physical measurements were made including height, weight, waist and hip circumference, heart rate and blood pressure. Blood pressure was measured twice using a UA-779 digital monitor after participants had remained at rest in a seated position for at least 5 min. A 10-ml blood sample was collected, and a venous blood spot test for random glucose level was done. The physical measurement procedures were standardized across the 10 study areas, and all physical measurements were made by trained study personnel. All devices used were regularly maintained and calibrated to ensure consistency of measurements.

Ethical approval for the China Kadoorie Biobank (CKB) was obtained from the Ethical Review Committee of the Chinese Center for Disease Control and Prevention (Beijing, China) and the Oxford Tropical Research Ethics Committee, University of Oxford (UK). All participants provided written informed consent.

Assessment of alcohol consumption

In the baseline survey questionnaire, participants were asked how often they had drunk alcohol during the previous 12 months (never or almost never; occasionally; only at certain seasons; every month but less than weekly; usually at least once a week). Those who had not drunk weekly in the past

12 months were asked if there was period of at least a year prior to that when they had drunk some alcohol at least once a week.

Those who had drunk weekly in the past 12 months were asked further questions about: frequency of drinking (1–2, 3–5 or 6–7 days per week); types of beverage (beer, grape wine, rice wine, weak spirits <40% alcohol content, strong spirits \geq 40% alcohol content) and amount of alcohol drunk [reported by number of small (250 ml) or large (640 ml) bottles for beer, and number of liang (50 g) for wines and spirits] both on a typical drinking day, on special occasions and at the last time of drinking; experience of indicators of problem drinking in the past month (drinking in the morning, unable to work or do anything due to drinking, depressed, irritated or loss of control due to drinking, unable to stop drinking, shakes when stopping drinking); time of drinking in relation to meals; at what age they started drinking weekly; whether their consumption had changed significantly in the past few years; and the experience of flushing or dizziness after drinking, which in China is often due to genetically determined deficiency in alcohol metabolizing enzymes.¹⁷

For this report, participants were classified into five main drinking categories: abstainers were defined as those who had never or almost never drunk alcohol in the past 12 months and had not drunk weekly in the past; ex-weekly drinkers as those who had never or almost never drunk alcohol in the past 12 months but had drunk weekly in the past; reduced-intake drinkers as those who had drunk alcohol occasionally, at certain seasons, or every month but less than weekly, in the past 12 months but had drunk weekly in the past; occasional drinkers as those who had drunk alcohol occasionally, at certain seasons, or every month but less than weekly, in the past 12 months and had not drunk weekly in the past; and weekly drinkers as those who usually drank alcohol at least once a week during the past 12 months. These drinking categories are broadly in line with those discussed in the World Health Organization (WHO) guide for monitoring alcohol consumption,¹⁸ but use the additional information collected in the study questionnaire to classify participants based on current or past weekly drinking, which may have implications for assessing reliably the health effects of alcohol consumption.

Level of alcohol consumption was calculated as grams of pure alcohol per week, based on the beverage type, amount drunk and frequency (days per week), assuming the following alcohol content by volume (v/v) typically seen in China:² beer 4%, grape wine 12%, rice wine 15%, weak spirits 38% and strong spirits 53%. Only one beverage type was allowed to be reported for a typical drinking day, and this defined the type of beverage drunk habitually. This is a limitation of the study questionnaire, but is in line with a previous study we conducted in China where over 95% of drinkers consumed a

single beverage type.¹³ Heavy drinking episodes were classified as the consumption of >60 g of alcohol on one occasion for men, and >40 g for women.¹⁸

Statistical methods

Percentages of the population in each category of alcohol consumption, and the mean alcohol consumption per week, were directly standardized to the age (in 10-year groups) and area (10 groups) structure of the study population. Associations between socio-demographic variables and alcohol drinking category were evaluated with a chi-square test for association, controlling for age and area. Associations of mean weekly alcohol consumption with these variables were evaluated using the type III Wald chi-square from a general linear model, adjusted for age and area.

Baseline characteristics presented by drinking category were also directly standardized as above. For variables measured in weekly drinkers, standardization was done according to the age and area structure of weekly drinkers. Heterogeneity of baseline characteristics across drinking categories, and trend by amount drunk in weekly drinkers, were evaluated with a type III Wald chi-square from a logistic or general linear model, adjusted for age and area. Analyses further adjusted for smoking status used the smoking categories current regular, ex-regular, occasional and never.

All analyses were done separately by gender. Analyses were done in SAS version 9.2.

Results

Overall, 76% of men and 36% of women surveyed reported having drunk some alcohol in the past year, with 33% of men and 2% of women drinking at least weekly (Table 1). In men, the prevalence of weekly drinking was higher at younger ages, in urban areas and in those with higher income, but varied little by education. The mean amount of alcohol consumed by male weekly drinkers was 286 g/week (i.e. four drinks a day on average assuming one drink contains 10 g of pure alcohol), and was higher in rural than in urban drinkers (333 g/week vs 238 g/week, $P < 0.001$), and in drinkers with less education or lower income. In women the mean amount consumed by weekly drinkers was 116 g/week (i.e. one to two drinks a day) and was also higher in rural areas and in those with less education and income. The mean age at which weekly drinking started was 28 years in male and 38 years in female weekly drinkers. Nine percent of men were either ex-weekly drinkers or had reduced their intake from weekly drinking in the past to occasional drinking, and this prevalence increased with age. In men and women, the prevalence of occasional drinking was higher at younger ages, and in those with more education.

Table 1 Prevalence of drinking alcohol and amount drunk, by socio-demographic characteristics

	N	Current non-drinkers		Current drinkers			Weekly Mean ^b (S.E.) g/week
		Abstainers %	Ex-weekly %	Reduced-intake %	Occasional %	%	
Men							
All	210 222	20.3	3.8	4.9	37.7	33.3	286 (0.9)
Region ^a							
Urban	91 339	15.1	3.1	5.3	38.0	38.5	238 (1.1)
Rural	118 883	24.3	4.3	4.6	37.4	29.3	333 (1.4)
Age group (years) ^a							
30-39	29 594	14.2	1.1	2.9	48.0	33.8	256 (2.4)
40-49	59 230	15.4	1.9	4.0	41.1	37.6	287 (1.6)
50-59	63 715	19.7	3.7	5.7	36.2	34.7	301 (1.6)
60-69	41 331	27.5	6.6	6.3	31.9	27.7	275 (2.0)
70-79	16 352	33.6	8.1	5.6	29.5	23.2	244 (3.4)
Highest education level ^a							
No formal school	18 660	26.7	5.1	4.7	31.6	31.9	324 (11.8)
Primary school	70 110	22.0	4.4	4.9	35.0	33.7	311 (3.5)
Middle/high school	104 899	19.4	3.4	5.1	39.1	33.0	272 (1.6)
College/university	16 553	16.0	2.7	5.4	46.0	29.9	210 (6.0)
Annual household income (yuan) ^a							
<10 000	54 737	23.7	5.0	4.6	35.9	30.8	300 (3.8)
10 000-19 999	59 558	20.9	4.1	4.8	37.1	33.1	291 (1.9)
20 000-34 999	53 400	19.3	3.5	5.3	37.8	34.0	284 (2.2)
≥35 000	42 527	16.2	3.3	6.3	36.7	37.5	274 (3.2)
Occupation ^a							
Agricultural	91 274	24.5	4.3	3.9	34.8	32.6	312 (3.5)
Factory	40 224	18.6	2.6	4.9	38.8	35.1	283 (4.1)
Professional/sales	32 529	16.4	3.2	5.7	39.7	35.0	268 (3.3)
Retired/other	46 195	25.8	6.0	6.2	32.9	29.1	304 (6.2)
Women							
All	302 669	63.6	0.4	0.3	33.5	2.1	116 (1.6)
Region ^a							
Urban	134 847	60.9	0.2	0.3	36.5	2.1	68 (1.5)
Rural	167 822	65.4	0.7	0.6	31.3	2.1	150 (2.4)
Age group (years) ^a							
30-39	48 210	57.9	0.1	0.2	40.3	1.5	93 (4.4)
40-49	93 519	58.8	0.2	0.3	38.5	2.1	115 (2.8)
50-59	93 841	65.1	0.5	0.6	31.7	2.1	119 (3.0)
60-69	50 440	70.5	0.9	0.6	25.6	2.4	111 (3.1)
70-79	16 659	73.7	1.1	0.5	22.1	2.6	105 (5.0)
Highest education level ^a							
No formal school	76 561	71.0	0.6	0.5	25.6	2.3	133 (4.6)
Primary school	95 106	67.6	0.4	0.4	29.6	1.8	120 (5.4)
Middle/high school	117 541	60.8	0.4	0.4	36.3	2.0	103 (3.5)
College/university	13 461	47.8	0.1	0.2	49.7	2.1	106 (4.8)

(continued)

Table 1 Continued

	N	Current non-drinkers		Current drinkers			Weekly
		Abstainers %	Ex-weekly %	Reduced-intake %	Occasional %	%	Mean ^b (S.E.) g/week
Annual household income (yuan) ^a							
<10 000	90 095	67.7	0.5	0.4	29.5	1.9	122 (3.1)
10 000-19 999	89 455	64.8	0.4	0.4	32.6	1.8	114 (3.2)
20 000-34 999	73 321	61.3	0.4	0.5	35.8	2.0	108 (5.9)
≥35 000	49 798	57.4	0.4	0.5	39.0	2.7	95 (10.6)
Occupation ^a							
Agricultural	122 733	70.6	0.5	0.4	26.4	2.1	141 (2.5)
Factory	32 171	62.2	0.2	0.4	35.0	2.1	102 (16.6)
Professional/sales	33 644	57.3	0.3	0.5	39.2	2.7	115 (21.4)
Retired/other	114 121	67.6	0.5	0.5	29.7	1.7	114 (8.5)

Prevalences and means are adjusted for age and area, as appropriate.

^aAssociations between alcohol drinking category and socio-demographic variables, after adjusting for age and area, were evaluated with a chi-square test for association: $P < 0.0001$ across all variables in men and women.

^bDifferences in mean alcohol intake across variables, after adjusting for age and area, were assessed using a general linear model: $P < 0.0001$ across all variables except age in women ($P = 0.005$).

Most male and female weekly drinkers consumed spirits on a typical drinking day (70% and 62%, respectively). In rural areas, strong spirits were consumed by 62% of male drinkers and 76% of female drinkers (Table 2). Weak spirits were also commonly consumed by rural drinkers (26% of men and 13% of women). In urban areas, 32% of male drinkers drank strong spirits, 30% beer, 20% weak spirits and 17% rice wine. Female urban drinkers drank beer (41%), grape wine (22%), strong spirits (16%) and weak spirits (13%). Strong-spirit drinkers consumed on average over twice as much alcohol (mean 352 g/week in men, 163 g/week in women) as those who drank beer (146 g/week in men, 60 g/week in women). Considering the proportion drinking each beverage type and the mean amount consumed (Table 2), 82% of the alcohol (g/week) consumed by weekly drinkers in the study population came from spirits (59% from strong spirits and 23% from weak spirits) with beer, rice wine and grape wine accounting for 10%, 8% and <1%, respectively.

There was large variation in the prevalence and patterns of drinking by study area in both men and women (see Supplementary Figure 1 for a map showing the location of the 10 study areas, available at IJE online). In men, the prevalence of current weekly drinking ranged from 7% (Gansu) to 51% (Harbin) and the mean amount consumed per drinker from 195 g/week (Harbin) to 422 g/week (Sichuan) (Figure 1). Spirit drinking, particularly strong spirits, was predominant in four rural areas (Sichuan, Henan, Hunan and Gansu), beer drinking common only in the two most northern cities (Harbin and

Qingdao) and wine drinking (mainly rice wine) frequent in southern and coastal areas (Liuzhou, Haikou, Suzhou and Zhejiang). Substantial regional variation was also seen in women, with the prevalence of current weekly drinking ranging from 0.2% (Gansu) to 6% (Sichuan) and mean consumption from 53 g/week (Liuzhou) to 182 g/week (Sichuan) (Supplementary Figure 2, available as Supplementary data at IJE online).

A high proportion of male weekly drinkers reported heavy drinking episodes (i.e. >60 g of alcohol in a drinking session) on a weekly basis (37%) or on special occasions (84%), and the prevalence was generally highest at younger ages (Figure 2). Drinking daily or almost daily was reported by 62% of male weekly drinkers (21% of all men), and the prevalence increased sharply with age. At all ages most male weekly drinkers usually drank with meals (86% overall), but this varied greatly by area from 20% (Gansu) to 99% (Suzhou). Beer drinking was more common among younger people, with 34% of male weekly drinkers aged 30–39 years drinking beer compared with 8% of those aged 70–79 years. Conversely younger drinkers, particularly in urban areas, were less likely than older drinkers to drink spirits. Drinking patterns by age and region in the 6248 female weekly drinkers were broadly similar to those in men (Supplementary Figure 3, available as Supplementary data at IJE online).

In both men and women, heart rate and blood pressure were positively associated with amount of alcohol consumed. In male weekly drinkers, each 140 g/week (or 20 g/day) of alcohol consumed was

Table 2 Type of alcohol and amount consumed in weekly drinkers, by region

	N	Strong spirits (≥40% v/v)		Weak spirits (<40% v/v)		Beer		Rice wine		Grape wine	
		%	Mean (S.E.) g/week	%	Mean (S.E.) g/week	%	Mean (S.E.) g/week	%	Mean (S.E.) g/week	%	Mean (S.E.) g/week
Men											
All	69 904	46.8	352 (1.5)	22.8	298 (1.9)	18.2	146 (1.3)	11.3	209 (2.1)	0.9	73 (4.0)
Rural	34 881	61.5	373 (2.0)	25.7	318 (2.6)	6.4	118 (3.1)	6.2	227 (4.0)	0.3	119 (13.2)
Urban	35 023	32.2	315 (2.2)	20.1	273 (2.6)	29.7	153 (1.4)	16.6	202 (2.5)	1.5	66 (4.2)
Women											
All	6 248	49.1	163 (2.6)	12.7	97 (4.0)	22.2	60 (1.8)	6.2	66 (4.1)	9.8	30 (1.2)
Rural	3 428	75.9	173 (2.9)	12.8	99 (4.9)	4.8	59 (6.1)	5.1	80 (6.5)	1.4	37 (4.8)
Urban	2 820	16.0	120 (4.9)	13.3	97 (6.7)	40.7	63 (1.8)	8.2	55 (5.3)	21.7	31 (1.3)

Prevalences and means are adjusted for age.

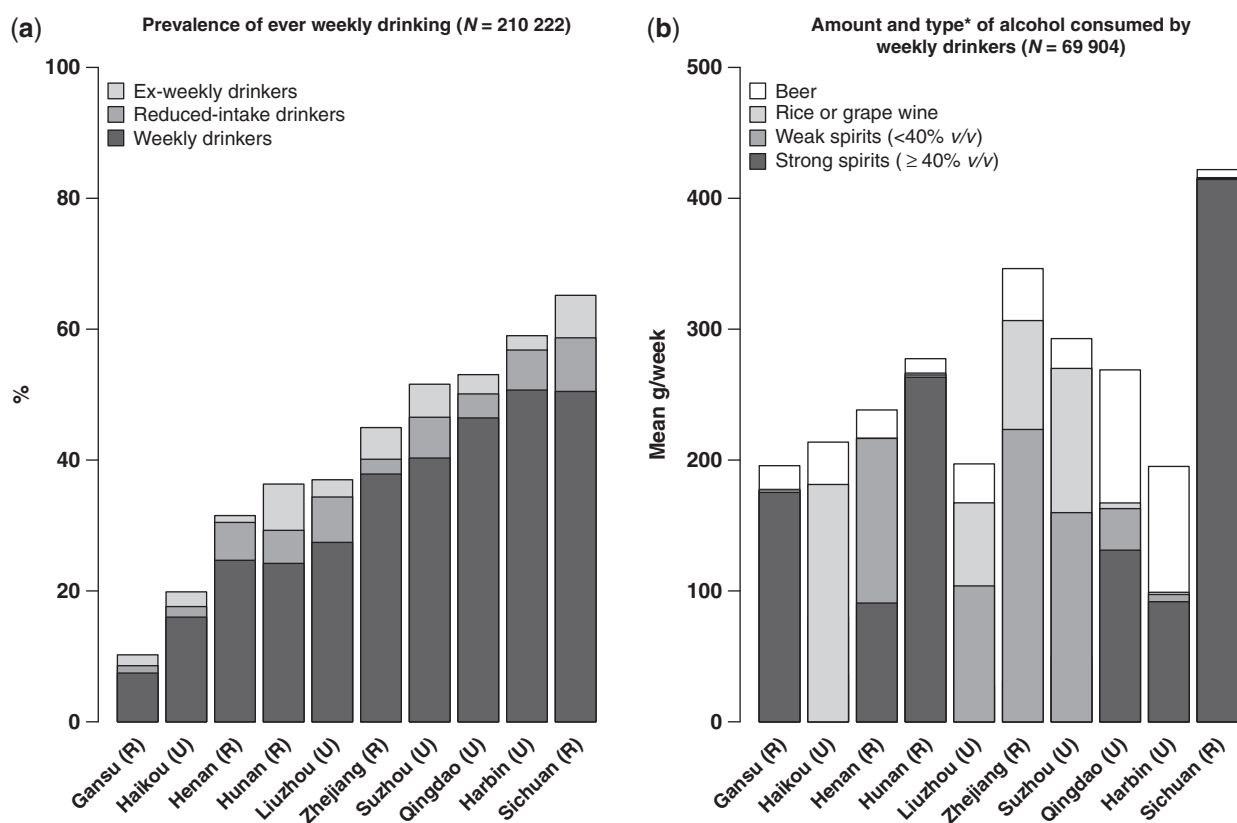


Figure 1 Prevalence of drinking and amount and type of alcohol drunk among men, in the 10 study areas. Prevalence estimates and mean amount drunk are adjusted for age. The shaded areas in (b) represent the proportion (%) of drinkers in each area consuming each type of alcohol (*only one type was reported for each drinker). Areas are ordered by prevalence of ever weekly drinking. U, urban; R, rural

associated with approximately 2 mmHg higher systolic and 1 mmHg higher diastolic blood pressure, and 1 beat per min higher heart rate (Table 3). There was no apparent relationship between alcohol consumption and body mass index in men or women, although

waist:hip ratio tended to be slightly higher in heavy drinkers (Table 3 and Supplementary Table 1, available as Supplementary data at IJE online).

There was a strong correlation between drinking alcohol and smoking in men, with the prevalence of

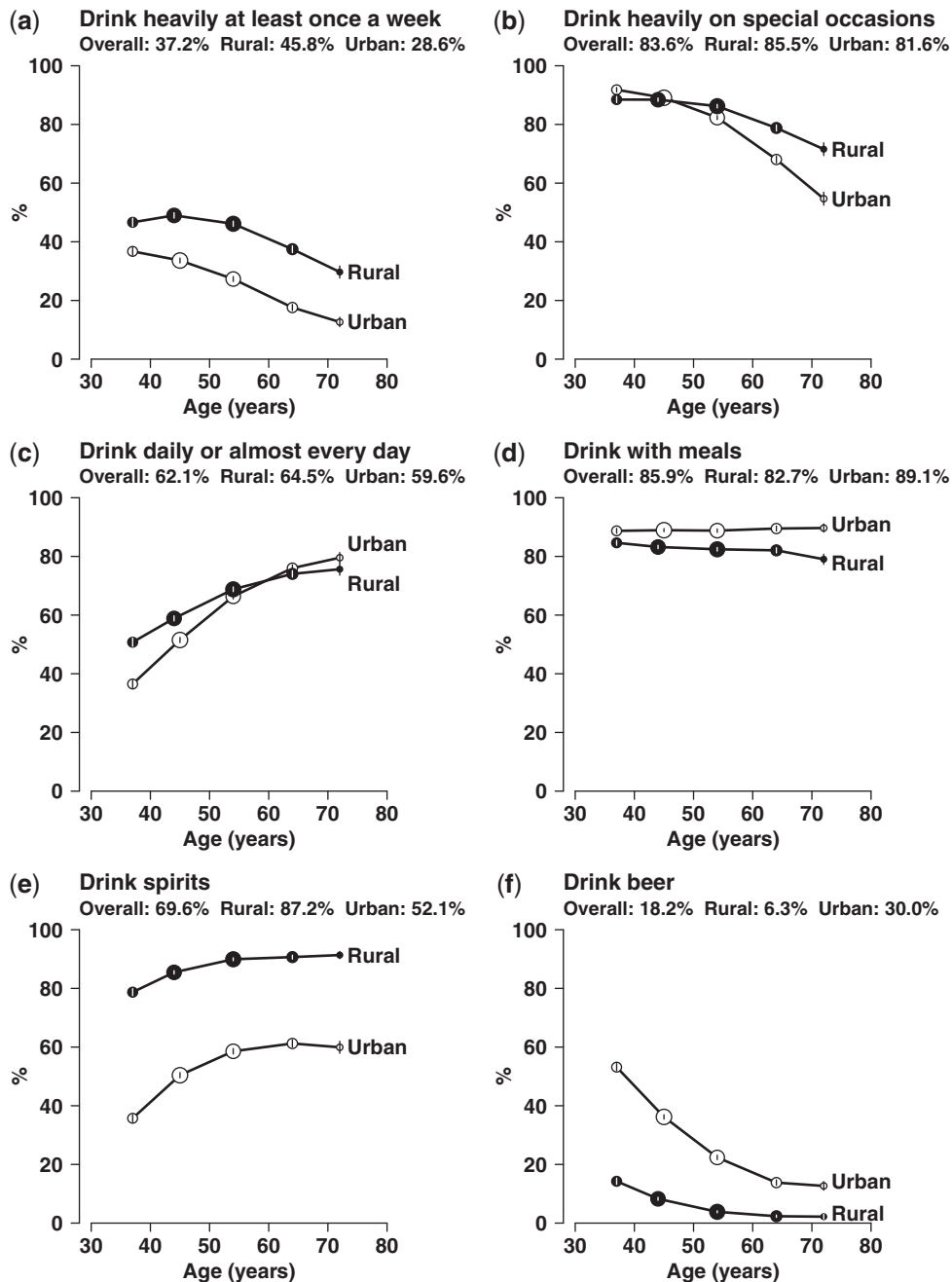


Figure 2 Drinking patterns in 69 904 male weekly drinkers, by age group. The prevalence in weekly drinkers in urban and rural regions of: (a) drinking heavily (>60 g in one session) at least once a week; (b) drinking heavily on special occasions; (c) drinking daily or almost every day; (d) drinking usually with meals; (e) drinking spirits; (f) drinking beer. Values are plotted at the mean age of each 10-year age group. Error bars are 95% confidence intervals. The circle area is proportional to the sample size

current regular (i.e. weekly) smoking lowest in abstainers (52%), and highest (80%) in the heaviest drinkers. As smoking may confound relationships between alcohol and health-related characteristics, analyses were also done adjusted for smoking status, which did not materially alter the associations (data not shown). Current weekly tea drinking was also correlated with alcohol consumption in men

(43% in abstainers compared with 62% in the heaviest drinkers). Ex-weekly drinkers, followed by those who had reduced their intake, reported the highest levels of physician-diagnosed chronic diseases and were most likely to self-report poor health among men and women (Table 3 and Supplementary Table 1, available as Supplementary data at *IJE* online).

Table 3 Association of alcohol consumption with selected variables in 210222 men

	Current non-drinkers					Current drinkers						
	Abstainers	Ex-weekly	Reduced-intake	Occasional	Weekly	Amount drunk by weekly drinkers Category (g/week) (mean of each category)						
						<140 (80)	140-279 (223)	280-419 (370)	420+ (690)	P-trend ^a	Heavy episodic drinking	
Number of men (N)	42764	7923	10371	79260	69904	25096	18910	12830	13068			26014
Mean age (years)	56.5	58.7	54.6	50.5	51.0	51.0	51.2	50.3	49.7	0.0001		49.3
Mean BMI (kg/m ²)	23.3	23.7	24.0	23.4	23.4	23.4	23.5	23.5	23.6	0.03		24.0
Mean waist:hip ratio	0.90	0.91	0.91	0.90	0.91	0.90	0.91	0.91	0.92	<0.0001		0.92
Mean SBP (mmHg)	131.9	134.2	133.7	131.0	134.3	132.1	134.5	135.9	137.7	<0.0001		136.7
Mean DBP (mmHg)	78.3	79.7	79.6	78.2	80.4	79.1	80.4	81.4	82.3	<0.0001		82.6
Mean heart rate (beats/minute)	77.9	78.9	77.8	76.9	78.4	77.2	78.3	79.2	81.0	<0.0001		79.9
Mean random blood glucose (mmol/L)	6.0	6.2	6.1	5.9	5.9	5.9	5.9	5.9	6.0	<0.0001		6.1
Mean MET hours/week	9.1	8.8	9.3	9.5	9.5	9.5	9.5	9.5	9.4	0.32		9.8
Regular smoker (%)	52.3	53.6	64.7	56.9	71.7	65.8	73.1	76.3	79.8	<0.0001		77.4
Regular tea-drinker (%)	43.1	46.7	52.8	46.7	60.0	58.9	59.1	59.6	62.1	<0.0001		62.4
Self-reported poor health (%)	12.8	23.5	14.0	7.7	5.9	6.1	6.0	5.5	6.7	0.95		6.8
History of chronic disease ^b (%)	27.3	46.0	33.5	21.2	17.9	19.2	17.8	17.1	18.0	<0.0001		18.1
Flushing response after drinking (%)					18.0	24.1	16.2	13.3	8.4	<0.0001		12.0
Problem drinking indicators ^c (%)					23.9	10.7	23.1	31.6	41.5	<0.0001		33.2

Prevalences and means are adjusted for age and area. BMI, body mass index; S/DBP systolic/diastolic blood pressure; MET, metabolic equivalent task.

^aP for trend by amount drunk category within weekly drinkers (P for heterogeneity across the five main drinking categories was <0.0001 for all variables).

^bDiagnosed with one or more of: coronary heart disease, stroke, transient ischaemic attack, diabetes, cancer, tuberculosis, chronic hepatitis/cirrhosis, rheumatoid arthritis, peptic ulcer, chronic respiratory disease, gallstone/gallbladder disease, kidney disease.

^cReporting one or more in the past month of: drinking in the morning, unable to work or do anything due to drinking; depressed irritated or lost control due to drinking; couldn't stop drinking; had shakes when stopped drinking.

A flushing response (hot flushes or dizziness) after drinking a small amount of alcohol was reported by 18% of men and 24% of women who drank weekly. This prevalence was inversely associated with amount drunk (Table 3 and Supplementary Table 1), and on average those who experienced a flushing response after drinking consumed less alcohol compared with those who did not (mean 205 g/week vs 303 g/week in men, 98 g/week vs 121 g/week in women, both $P < 0.0001$). The prevalence of flushing did not vary much with age, but in male weekly drinkers it ranged from 8% (Haikou) to 29% (Sichuan) across the 10 study areas (data not shown).

Potential indicators of problem drinking (including one or more of: drinking in the morning, being unable to work or do anything due to drinking; feeling depressed, irritated or losing control due to drinking; being unable to stop drinking; and having shakes when stopping drinking) were reported by 11% of male weekly drinkers consuming <140 g/week compared with 42% of men consuming over 420 g/week (Table 3), and by 4% of female weekly drinkers consuming <70 g/week compared with 30% of women drinking over 280 g/week (Supplementary Table 1).

Discussion

This is one of the largest studies of the prevalence and patterns of alcohol consumption in China. In this study, drinking alcohol was much more frequent in men than women and there was striking regional variation in drinking patterns as well as in the types of alcohol consumed, reflecting the level of geographical, economic and cultural diversity present within China. A clustering of lifestyle behaviours associated with alcohol drinking was also observed, with weekly drinkers more likely to smoke and drink tea regularly. Most people drank with meals, largely reflecting traditional Chinese customs; however, heavy episodic drinking was common among younger people, perhaps reflecting a tendency towards more Western drinking styles. Although the study was not designed to be nationally representative, these results provide unique and reliable information about drinking habits in China at a time of rapid economic and social change, when there is a growing risk of alcohol-related health problems.

The overall findings in our study are broadly consistent with those from a nationally representative study of 220 000 men in China, conducted in 1990–91, where the prevalence of regular drinking was also 33%, and heavy consumption was more frequent in rural areas.¹³ A more recent nationally representative survey of 50 000 adults in 2007 reported 56% of men and 15% of women drinking alcohol in the past year.¹⁴ In a survey conducted in 2001 among 25 000 adults from five provinces, 75% of men and 39% of women reported drinking alcohol at least once in the past year,⁶ and in a similar survey conducted 6 years

earlier, the rates were 84% in men and 29% in women.⁵ Other studies conducted in particular regions of China have reported the prevalence of drinking ranging from 58 to 90% for men and 12 to 55% for women.^{19–21} Although the overall prevalence and frequency of alcohol drinking in this Chinese population is lower than that typically seen in many Western populations,⁴ the regional variation observed is probably much more extreme. This is consistent with the substantial regional variation in alcohol drinking reported in a survey of 69 rural counties in China in 1989, in which the prevalence of ever regular drinking (at least three times a week for more than 6 months) in men varied from 3% to 82% across study sites.²² In common with previous reports from China and elsewhere,²³ drinking prevalence and consumption levels in our study were much higher among men than women.

A major characteristic of alcohol drinking in China is the widespread consumption of strong spirits in many parts of the country, particularly in the inland rural regions. In the study of 220 000 Chinese men, of whom three-quarters were from rural regions,¹³ 93% were strong spirit drinkers, which was comparable with some of the rural regions in our study. In our study population, over 80% of alcohol consumed was from spirits and 10% from beer. WHO recently reported that 57% of per capita alcohol consumption in China was from spirits and 34% from beer.⁴ These differences could be due to the much younger population of adults aged 15 years or above or the different regions surveyed in the WHO report. In the 2001 survey of 25 000 adults in five provinces, which had a large proportion of young people aged below 30 years from urban areas, beer was the most popular drink in their study population, followed by strong spirits.⁶ In our study population aged 30–79 years, beer drinking was most frequent among the younger drinkers, and was highest in Harbin and Qingdao, two northern cities which are famous for their beer production. Weaker spirits and traditional rice wine were relatively favoured in the more prosperous coastal and southern areas in our study, and consumption of grape wine was generally very low in all areas.

Smoking and alcohol consumption were highly correlated, as has been observed previously in China and elsewhere.^{24,25} This must be considered when assessing the health affects of alcohol, although adjustment for smoking did not substantially affect the correlations between alcohol and baseline health characteristics in our study. Drinking alcohol was also associated with tea drinking (mainly green tea), which may have some benefits for health.^{26,27} Whereas weekly drinking was most common among men living in urban areas, the heaviest drinkers tended to live in rural areas and have poorer education—patterns fairly consistent with other studies in China.^{20,28} People with high socioeconomic status

(e.g. greater education or income) were more likely than others to be occasional drinkers or, if weekly drinkers, to consume less, which may in turn represent a grouping of lifestyle and socioeconomic factors potentially advantageous to health.²⁹

Apart from the total amount consumed, patterns of consumption are also likely to influence the health effects of alcohol.⁷ Heavy drinking episodes (or 'binge drinking') may be particularly harmful to health and also increase the risk of injury and other immediate adverse consequences.¹⁸ Binge drinking among adolescents and young people has been rising in many Western populations, causing significant public health concern,³⁰ and in this adult population both weekly and occasional binge drinking were higher among younger people. A similar trend was also reported in a survey of 10 000 Chinese adults in Hong Kong,³¹ and a survey of 54 000 adolescents in 18 provincial capitals in China found 30% started to drink before the age of 13 years, and 10% reported at least one episode of binge drinking.³² Conversely, drinking alcohol with meals, which is thought to be less harmful to health,³³ is a common custom in China and was seen widely in the present study.

As expected, ex-weekly drinkers and those who had reduced their intake were more likely to have poor health status. This is particularly relevant to the appropriate control of reverse causality when assessing the prospective association of alcohol drinking with disease risks in the future.²⁹ Also as expected, a proportion of the population experienced flushing and dizziness in response to alcohol, symptoms of a deficiency in alcohol-metabolizing enzymes which is common in East Asian populations, and may modify the health effects of drinking alcohol.^{17,34} The observed association between blood pressure and alcohol consumption, a phenomenon widely reported in many populations, is of a similar magnitude to that reported in other studies i.e. an increase of approximately 2 mmHg systolic blood pressure per 20 g alcohol consumed each day,³⁵ which provides an important measure of validation for the self-reported alcohol measures collected in the present study.

To conclude, this large survey found that drinking alcohol remains a predominantly male phenomenon in Chinese adults, although for both men and women there is large heterogeneity in the prevalence and patterns of drinking by area, age, socioeconomic status and other lifestyle behaviours. The wide diversity of alcohol exposures in China creates particular challenges as well as opportunities for evaluating the health effects of alcohol consumption. Large prospective studies like the CKB with a range of measures for alcohol (as well as for other lifestyle and environmental factors), done in many different parts of China, will help to improve our understanding of the effects of alcohol on a wide range of fatal and non-fatal conditions in this country.

Supplementary data

Supplementary data is available at *IJE* online.

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KEY MESSAGES

- In the China Kadoorie Biobank population of middle-aged adults, drinking alcohol was much more frequent in men than in women.
- The prevalence and patterns of drinking varied widely by study area. Spirits were the most commonly consumed beverage, with strong spirits (over 40% alcohol content) predominant, particularly in rural areas.
- Heavy drinking episodes were widespread in men, on a regular basis as well as on special occasions, particularly among those aged below 50 years.
- Clustering of socio-demographic and behavioural factors potentially influencing health is seen, with heavy alcohol consumption correlated with lower education levels and regular smoking.
- Alcohol consumption is positively associated with systolic blood pressure, which provides validation of the self-reported alcohol intake measured in the study questionnaire.

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