

# BMJ Open Incidence rate, risk factors and behaviour changes for alcohol drinking: findings from a community-based cohort study in Southwest China

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**To cite:** Zhu B, Zhou J, Chen Y, *et al*. Incidence rate, risk factors and behaviour changes for alcohol drinking: findings from a community-based cohort study in Southwest China. *BMJ Open* 2022;**12**:e060914. doi:10.1136/bmjopen-2022-060914

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2022-060914>).

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Received 11 January 2022  
Accepted 18 August 2022



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## ABSTRACT

**Objective** To describe changes in alcohol drinking behaviour, estimate the incidence rate of alcohol drinking and explore its risk factors in the Chinese community population.

**Design** A community population prospective cohort study.

**Setting** A total of 48 townships of 12 counties or districts in Guizhou province, China.

**Participants** With the multistage proportional stratified cluster sampling method, a total of 7343 adult residents were enrolled into this study and eligible to be analysed.

**Primary and secondary outcome measures** The incidence rate and its risk factor (adjusted HR (aHR) and 95% CIs) as well as the prevalence of alcohol drinking.

**Results** There was a little increase trend in the overall prevalence of alcohol drinking among 7343 subjects over an average of 7.22-year follow-up, and the prevalence in women increased by 2.5% statistically ( $p=0.001$ ). Among 5005 non-drinkers in 7343 subjects at baseline, 1107 incident drinkers were identified, and the incidence rate of alcohol drinking was estimated at 30.63/1000 person-years with significant sex difference (57.46 vs 17.99 per 1000 person-years for men and women, respectively,  $p<0.001$ ). The incidence rate decreased gradually with age, peaking in men aged 18–29 years old and women aged 30–39 years old at baseline. After the adjustment for covariates, being male (aHR=3.46, 95% CI: 3.02 to 3.96), being non-Han Chinese (aHR=1.65, 95% CI: 1.44 to 1.88), living in urban areas (aHR=3.50, 95% CI: 3.01 to 4.08), being employed (aHR=1.33, 95% CI: 1.16 to 1.52), smoking (aHR=1.17, 95% CI: 1.00 to 1.38) and having no history of chronic diseases (aHR=1.19, 95% CI: 1.04 to 1.35) were independent risk factors for incident drinkers.

**Conclusion** The number of women increased in the prevalence of alcohol drinking significantly although there was no significant overall change for the cohort population in Southwest China. Also, there was a high risk of developing alcohol drinking among the study population, especially for those non-drinkers who were younger men, non-Han Chinese, living in urban areas, employed, current smokers or without any chronic diseases. Interventions to prevent and manage alcohol consumption should be designed and implemented in Chinese communities as soon as possible.

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This is the first study in China on the risk of developing alcohol drinking among the Chinese community population and prospectively identified its risk factors.
- ⇒ This study has relatively high follow-up rate (86.6%) during follow-up.
- ⇒ There is a possibility of report bias in the collection of alcohol drinking information with the questionnaire in this study.
- ⇒ With only one follow-up, the average time of the onset of incident drinking may bias the incidence rate of alcohol drinking in this cohort.

## INTRODUCTION

Cigarette smoking, alcohol drinking and physical activity (PA) are all linked to the occurrence of chronic diseases such as cancer and cardiovascular disease, and premature death.<sup>1</sup> Alcohol use is a major contributor to the global burden of disease. According to the estimate by WHO, alcohol use is responsible for approximately 3.3 million deaths worldwide each year.<sup>2</sup> In China, drinking alcohol was a widely accepted cultural tradition, especially during rituals, festivals, social gatherings, commercial occasions and special activities.<sup>3</sup> In 2016, the alcohol drinking prevalence of Chinese men and women was 48% and 16%, respectively, and China had the highest number of deaths attributed to alcohol (650 000 for men and 59 000 for women) worldwide.<sup>4</sup>

Most researches on alcohol consumption were focused on the aetiology of adults, mainly in the physiological and clinical analysis, or the alcohol-related health harms.<sup>4</sup> Most studies on changes in alcohol drinking behaviour used official statistics such as tax and sales data of alcohol consumption, or estimates based on self-reported alcohol consumption data from the population

**Table 1** General characteristics of this study population at baseline in Southwest China (%)

Characteristics	Overall	Non-drinker	Drinker	P value
	n=7343	n=5005	n=2338	
Male	3422 (46.6)	1590 (31.8)	1832 (78.4)	<0.001
Age, years (mean±SD)	44.4±15.0	44.3±15.3	44.6±14.3	0.529
18–29	1416 (19.3)	1005 (20.2)	411 (17.6)	<0.001
30–39	1573 (21.4)	1078 (21.5)	495 (21.2)	
40–49	1853 (25.3)	1233 (24.6)	620 (26.5)	
50–59	1294 (17.6)	827 (16.5)	467 (20.0)	
≥60	1207 (16.4)	862 (17.2)	345 (14.7)	
Urban	2359 (32.1)	1655 (33.1)	704 (30.1)	0.012
Non-Han Chinese	3080 (41.9)	1988 (39.7)	1092 (46.7)	<0.001
Unmarried	1417 (19.3)	959 (19.2)	458 (19.6)	0.688
Farmer	4237 (57.7)	2902 (58.0)	1335 (57.1)	<0.492
Education (≤9 years)	6351 (86.5)	4442 (88.8)	1909 (81.7)	<0.001
Annual household income (<¥200 000 CNY)*	4147 (56.5)	2659 (53.1)	1488 (63.6)	<0.001
Current smokers	2057 (28.0)	687 (13.7)	1370 (58.6)	<0.001
Physical activity	6425 (87.5)	4287 (85.7)	2138 (91.4)	<0.001
BMI, kg/m <sup>2</sup> (mean±SD)*	22.93±3.37	22.92±3.35	22.95±3.41	0.663
<22.0	3214 (43.8)	2201 (44.1)	1013 (43.3)	0.267
22.0–23.9	1729 (23.6)	1170 (23.4)	559 (23.9)	
24.0–27.9	1857 (25.3)	1244 (24.9)	613 (26.3)	
≥28.0	530 (7.3)	378 (7.6)	152 (6.5)	
History of chronic diseases†	4944 (67.3)	3256 (65.1)	1688 (72.2)	<0.001

\*Missing value.  
†Chronic diseases include diabetes mellitus, hypertension and dyslipidaemia at baseline.  
.BMI, body mass index; CNY, Chinese Yuan.

with a small sample size.<sup>5 6</sup> The quantity and frequency of personal alcohol use and its risk were determined by a variety of influencing factors including social factors such as historical time, social culture and geopolitical context; individual-level factors such as family history and effects of prenatal alcohol exposure; psychological factors and sociodemographic features (eg, gender, age, race, ethnicity, culture, religious affiliation and socioeconomic status).<sup>7–14</sup> Most of them were cross-sectional or multistage cross-sectional studies to describe the changes in alcohol drinking behaviour and the factors influencing these changes.<sup>7 15 16</sup> However, as one of the most important health-related behaviours, there was no prospective study reported on the trend of alcohol drinking behaviour based on a same community cohort population so far.

Also, only few cohort studies focused on incident alcohol drinking (or initial alcohol drinking) among adolescents.<sup>17 18</sup> One previous study in the USA found that among early adolescent new drinkers (drinking onset at age 11–14 years), incident drinking girls progressed to heavy drinking episode more quickly than boys at or after age 15 years.<sup>17</sup> Another study in the USA showed that there were rising age-specific drinking incidence rates across adolescence to plateau at age 16–18 years, dipping

at age 19–20 years, peaking at age 21 years and sharply reducing incidence thereafter.<sup>18</sup> Over the past decades, health-related lifestyles including alcohol drinking have changed dramatically worldwide.<sup>5 6</sup> So far, the incidence rate and risk factors of alcohol drinking among the adult community population are unclear. This study aimed to describe changes in alcohol drinking behaviour, estimate the incidence rate of alcohol drinking and explore its risk factors in the adult Chinese population.

## MATERIAL AND METHODS

### Study design and population

The Guizhou Population Health Cohort Study is a prospective community-based cohort in Guizhou province, China.<sup>19</sup> Based on the multistage proportional stratified cluster sampling method, a total of 9268 adult residents from 48 townships of 12 counties or districts in Guizhou province were recruited into this study from 2010 to 2012. The inclusion criteria were met as follows: (1) those who were 18 years or older; (2) those who lived in the study region and having no plans of moving; (3) those who completed a survey questionnaire with full

**Table 2** Changes of alcohol drinking behaviour between the baseline and follow-up

Phase	Alcohol drinking			Excessive alcohol drinking			ADAI, g/day (mean±SD)		
	Male n (%)	Female n (%)	All n (%)	Male n (%)	Female n (%)	All n (%)	Male	Female	All
Baseline	1832 (53.5)	506 (12.9)	2338 (31.8)	650 (36.2)	71 (14.5)	721 (31.6)	28.2±39.8	7.6±15.7	23.8±37.1
Follow-up	1776 (51.9)	604 (15.4)	2380 (32.4)	547 (32.0)	98 (17.5)	645 (28.4)	28.0±68.5	9.1±21.7	23.2±60.9
Change	-1.6	2.5	0.6	-4.2	3.0	-3.2	-0.2	1.5	-0.6
χ <sup>2</sup> or t value	1.838	10.079	0.551	6.946	1.787	5.301	0.143	-1.342	0.414
P value	0.175	0.001	0.458	0.008	0.181	0.021	0.886	0.186	0.679

ADAI, average daily alcohol intake.

alcohol drinking data at baseline and follow-up; (4) those who signed the written informed consent form.

Trained health professionals used a structured questionnaire through a face-to-face interview to collect the information on demographic variables (sex, age, ethnicity, education, marriage status and occupation), lifestyle (smoking status, alcohol usage and PA) and history of chronic diseases. All participants were followed up for lifestyle factors, major chronic diseases and vital status through a repeated investigation during 2016–2020, and 1117 (12.04%) were lost to follow-up. All deaths were confirmed through the Death Registration Information System and Basic Public Health Service System. We excluded 17 people who had missing alcohol drinking data at baseline and 791 people who had missing alcohol drinking

data at follow-up, respectively. The remaining 7343 participants were analysed for the changes in alcohol drinking behaviour. Furthermore, we excluded 2338 people who drank at baseline, and finally, 5005 non-drinkers were eligible for the analysis of incident alcohol drinking (online supplemental figure 1).

### Anthropometric and laboratory measurements

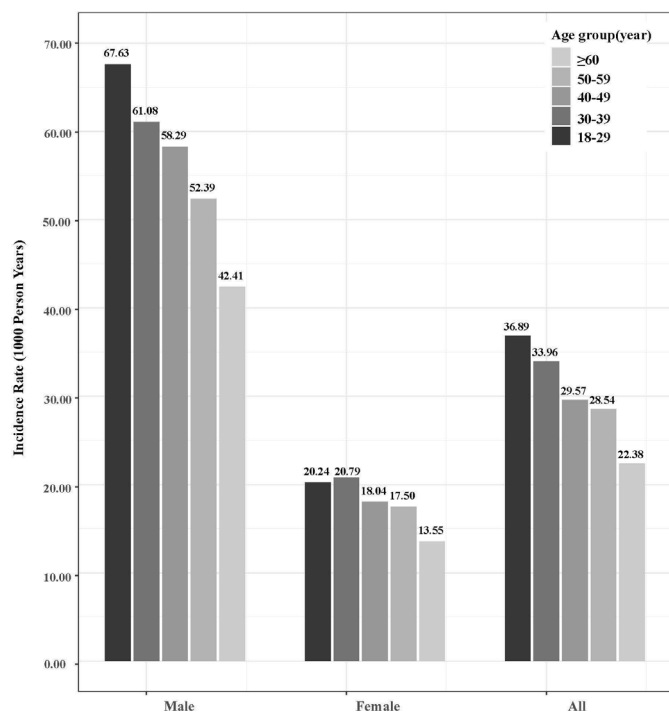
The anthropometric measurements, including height, body weight, waist circumference (WC) and blood pressure, were measured by trained local health professionals. Standing height was recorded to the nearest 0.1 cm by a portable stadiometer. Weight was numbered to the nearest 0.1 kg using a digital weighing scale. WC was measured to the nearest 0.1 cm at the midpoint between the lowest rib margin and

**Table 3** Population baseline characteristics among non-drinkers at baseline over incident alcohol drinking status (%)

Characteristics	Overall n=5005	Non-drinker n=3898	Incident alcohol drinker n=1107	P value
Male	1590 (31.8)	925 (23.7)	665 (60.1)	<0.001
Age, years (mean±SD)	44.3±15.3	45.1±15.3	41.9±14.8	<0.001
18–29	1005 (20.2)	732 (18.8)	273 (24.7)	<0.001
30–39	1078 (21.5)	811 (20.8)	267 (24.1)	
40–49	1233 (24.6)	971 (24.9)	262 (23.7)	
50–59	827 (16.5)	660 (16.9)	167 (15.1)	
≥60	862 (17.2)	724 (18.6)	138 (12.4)	
Urban	1655 (33.1)	1251 (32.1)	404 (36.5)	0.007
Non-Han Chinese	1988 (39.7)	1519 (39.0)	469 (42.4)	0.045
Unmarried	959 (19.2)	708 (18.2)	251 (22.7)	<0.001
Employed	4118 (82.3)	3170 (81.3)	948 (85.6)	0.001
Education (≤9 years)	4442 (88.8)	3486 (89.4)	956 (86.4)	0.005
Annual household income (<¥200 000 CNY)*	2659 (53.1)	2122 (54.4)	537 (48.5)	<0.001
Current smokers	687 (13.7)	433 (11.1)	254 (22.9)	<0.001
Physical activity	4287 (85.7)	3384 (86.8)	903 (81.6)	<0.001
Obesity*	4627 (92.4)	3580 (91.8)	1047 (94.6)	0.006
History of chronic diseases†	3256 (65.1)	2570 (65.9)	686 (62.0)	0.016

\*Missing value.

†Chronic diseases include diabetes mellitus, hypertension and dyslipidaemia at baseline.  
CNY, Chinese Yuan.



**Figure 1** Data shown are incidence rates of alcohol drinking over age group and gender.

the iliac crest. Body mass index (BMI) was calculated as body weight in kilograms divided by square height in metres ( $\text{kg}/\text{m}^2$ ) and divided into four categories following the Chinese BMI classification standard (low normal weight  $<22.0$ ; high normal weight  $22.0$ – $23.9$ ; overweight  $24.0$ – $27.9$  and obese  $\geq 28.0$   $\text{kg}/\text{m}^2$ ).<sup>20</sup>

## DEFINITIONS

All definitions related to alcohol consumption are followed from the Dietary Guidelines for Chinese Residents (2016).<sup>21</sup> Drinkers were defined as those who consumed alcohol in the last 12 months.<sup>2</sup> Incident drinkers were those who drank alcohol first at any time during the follow-up. The consumption of concentrated liquor, low-concentrated liquor, beer, yellow rice wine, rice wine, wine and barley wine (alcohol degree was 52%, 38%, 4%, 18%, 18%, 10%, 3%) was recorded. Average daily alcohol intake (g) was calculated by average daily drinking weight multiplied by alcohol degree (recorded by weight) or calculated by average daily drinking volume multiplied by alcohol degree multiplied by ethanol density ( $0.789$   $\text{g}/\text{mL}$ ) (recorded by volume). Excessive drinking was defined as pure alcohol intake  $>25$   $\text{g}/\text{day}$  for male and  $>15$   $\text{g}/\text{day}$  for female.<sup>21</sup> The changes in alcohol drinking behaviour were assessed by the prevalence of alcohol drinking and excessive drinking among the study population, and average daily alcohol intake among alcohol drinkers. Chronic diseases were one of the diseases diagnosed with diabetes, hypertension or dyslipidaemia at baseline.<sup>19–21</sup> Those subjects who smoked in the previous 12 months were considered as current smokers. Annual household income was the income shared by

people living in the same household in the last year. PA included all kinds of PA in the past 12 months (farm work, work, housework, transportation-related PA, leisure exercise or sports, etc).

## Patient and public involvement

Patients and members of the public were not directly involved in this study. The study population was limited to the anonymised records of individuals in this study.

## STATISTICS ANALYSIS

The  $\chi^2$  test was used for categorical variables to compare the differences between incident drinkers and non-drinkers. The Student's t-test was applied for continuous variables. The person-years (PYs) of follow-up were calculated from the date of enrolling the cohort to the date of follow-up or death, whichever came first. We define crude incidence rate of alcohol drinking as:

$$\text{Crude incidence rate} = \frac{\text{number of incident alcohol drinkers}}{\sum \text{time spent in population}}$$

Cox proportional hazards regression model was used to determine the association between baseline factors and incident alcohol drinking. Covariates including age, sex, ethnicity, residence, education level, occupation, marriage status, smoking and history of chronic diseases were adjusted in Cox regression model. The Schoenfeld residuals were used to test the assumption of hazard proportionality in Cox regression models and no evidence of non-proportionality was found. All statistical tests were two sided and  $p < 0.05$  was considered statistically significant. All analyses were performed in R software (major packages: 'ezcox', 'survival', and 'survminer') (V.4.1.0; R Foundation for Statistical Computing, Vienna, Austria).

## RESULTS

### Characteristics of subjects at baseline

The general characteristics of 7343 eligible subjects at baseline were shown in table 1. Nearly half of all subjects were male, with an average age of  $44.4 \pm 15.0$  years old, and 31.8% were alcohol drinkers at baseline. Alcohol drinkers were more likely to live in rural areas and to be non-Han Chinese than non-drinkers. Also, male, subjects aged 40–49 years old comprised the higher proportion of alcohol drinkers. In addition, participants who were farmers, having a lower education level and a lower annual household income, current smokers, having PA or without any history of chronic diseases comprised the higher proportion of alcohol drinkers (table 1).

### Changes in alcohol drinking behaviour between baseline and follow-up

Among 7343 subjects, there was a little increasing trend in the overall prevalence of alcohol drinking during the follow-up, although it was not significant (table 2). However, such prevalence for female subjects increased by 2.5% significantly. Also, the prevalence of excessive drinking decreased by 3.2%, and there was greater reduction of 4.2% in male subjects statistically, but increased in

**Table 4** Cox regression on associations between risk factors and incident drinking

Potential factors	Case of incident drinking	Person-year (PY) of observation	IR (1000 PYs)	HR (95% CI)*	aHR (95% CI)†
Total	1107	36 137.23	30.63		
Gender					
Female	442	24 564.26	17.99	1.00	1.00
Male	665	11 572.97	57.46	3.10 (2.75 to 3.50)	3.46 (3.02 to 3.96)
Age, years					
18–29	273	7396.68	36.91	1.00	1.00
30–39	267	7862.44	33.96	0.98 (0.83 to 1.16)	1.01 (0.84 to 1.20)
40–49	262	8860.09	29.57	0.92 (0.77 to 1.09)	1.04 (0.86 to 1.25)
50–59	167	5851.17	28.54	0.94 (0.78 to 1.14)	1.00 (0.82 to 1.23)
≥60	138	6166.85	22.38	0.71 (0.58 to 0.87)	0.72 (0.58 to 0.90)
Urban					
No	703	24 932.37	28.20	1.00	1.00
Yes	404	11 204.86	36.06	2.30 (2.10 to 2.70)	3.50 (3.01 to 4.08)
Han Chinese					
Yes	638	21 887.41	29.15	1.00	1.00
No	469	14 249.82	32.91	1.20 (1.10 to 1.40)	1.65 (1.44 to 1.88)
Education					
>9 years	151	4082.76	36.98	1.00	1.00
≤9 years	956	32 054.47	29.82	0.82 (0.69 to 0.98)	1.14 (0.94 to 1.37)
Employed					
No	159	6457.90	24.62	1.00	1.00
Yes	948	29 679.33	31.94	1.30 (1.10 to 1.50)	1.33 (1.16 to 1.52)
Married					
Yes	856	29 149.81	29.37	1.00	1.00
No	251	6987.42	35.92	1.15 (1.01 to 1.33)	1.06 (0.91 to 1.24)
Current smokers					
No	853	31 167.35	27.37	1.00	1.00
Yes	254	4969.88	51.11	1.80 (1.60 to 2.10)	1.17 (1.00 to 1.38)
History of chronic diseases‡					
Yes	686	23 647.71	29.01	1.00	1.00
No	421	12 489.52	33.71	1.31 (1.16 to 1.48)	1.19 (1.04 to 1.35)

\*Univariate Cox regression.

†Multivariate Cox regression adjusted by all covariates excluding itself.

‡Chronic diseases include diabetes mellitus, hypertension and dyslipidaemia at baseline.

.aHR, adjusted HR; IR, incidence rate.

female subjects (3.0%). In addition, daily alcohol intake showed similar change to those prevalences.

#### Associations between potential risk factors at baseline and incident alcohol drinking

A total of 5005 non-drinkers at baseline was eligible for this analysis, and their general characteristics at baseline were presented in table 3. Of them, there was a mean age of 44.3±15.3 years old, and 31.8% were male. Compared with subjects who remained free of alcohol, incident drinkers were more likely to live in urban areas, be

non-Han Chinese, be male, be unmarried, be employed, have lower education level, have higher annual household income, be current smokers, have less PA, be not obese or have no history of chronic diseases.

During the mean (SD) follow-up of 7.22 (1.17) PYs that ranged from 5.05 years to 9.53 years, the crude incidence rate of incident alcohol drinking was 30.63 per 1000 PYs, and was significantly higher among men than that of women (57.46 vs 17.99 per 1000 PYs). The incidence decreased gradually with age, with a peak in 18–29

years old for men and 30–39 years old for women at baseline (figure 1). Univariate Cox regression showed that subjects who were male, living in urban areas, non-Han Chinese, had more than 9 education years, employed, current smokers or without any history of chronic diseases had higher risk of incident alcohol drinking. After the adjustment for covariates, it was discovered that subjects who were male, non-Han Chinese, living in urban areas, employed, current smokers and without any history of chronic diseases still had significantly higher risk of developing alcohol drinking (table 4).

## DISCUSSION

Over the past 10 years, the pattern of alcohol drinking behaviour was relatively stable in this study population. The overall prevalence of alcohol drinking increased a little during the follow-up without statistical significance, but increased significantly among women, which was consistent with previous studies.<sup>22 23</sup> Also, the prevalence of excessive alcohol drinking statistically decreased overall, and there was greater reduction in men, which was confirmed by a longitudinal study in China.<sup>24</sup> Although the prevalence of both alcohol drinking and excessive alcohol drinking was higher in men than in women, as reported in some previous studies,<sup>6 25–27</sup> it was noted that both increased among women. This may be due to recent changes in economic and social status in terms of developing stronger independent consciousness, increasing levels of employment, and increasing social activities and communication opportunities in women.<sup>12 28 29</sup> Those findings suggested that women should be a priority population for reducing alcohol consumption, particularly unhealthy alcohol drinking.

Another finding from this study was that the incidence of alcohol drinking was 30.63 per 1000 PYs among non-drinkers at baseline and decreased gradually with age, with a peak in 18–29 years old for men and 30–39 years old for women at baseline. Previous studies in China and Switzerland reported that people with high emerging adulthood were more likely to have moderate or excessive alcohol drinking behaviours.<sup>30 31</sup> One of the possible reasons that women reached their peak later than men may be marriage and childbirth, which reduced the chance to drink for younger women. Another reason was that women may get career promotion later than men,<sup>32</sup> which called for further researches to confirm that. Anyway, those findings implied that alcohol drinking intervention in earlier adulthood may be important.

Furthermore, even after adjustment for covariates, being male, being non-Han Chinese, living in urban areas, being employed, smoking and having no history of chronic diseases were still significantly associated with incident drinking. Results from China Kadoorie Biobank and some cross-sectional studies indicated that urban residents had a higher prevalence of current drinking.<sup>11 33</sup> Urban residents with higher risk of developing alcohol drinking may be related to their higher income, prevalent

consumption patterns and business demands. Non-Han Chinese had higher risk of becoming incident alcohol drinkers partly due to their different culture and tradition on alcohol drinking. In addition, employed subjects often had higher socioeconomic status, which was one of the important factors influencing alcohol use.<sup>34–36</sup> Subjects with a history of chronic diseases at baseline were more likely to know possible unhealthy impacts of alcohol drinking and further reduce or avoid such behaviour.

To our limited knowledge, this study was the first on the risk of incident alcohol drinking among the Chinese community population in China. One of the strengths of this study was its high follow-up rate (86.6%) during 10 years of follow-up. Another strength of this prospective study was identifying risk factors for incident alcohol drinking among the Chinese community population. However, this study had some notable limitations. First, there may be report bias in the acquisition of alcohol drinking information with the questionnaire in this study. Second, residual confounding may not be controlled well although major potential confounding factors had been adjusted in this analysis. Third, because of only one follow-up that ranged from 5.05 to 9.53 years and no data on initiation time, the incidence rate of alcohol drinking may be underestimated in this cohort. The incidence rate slightly increased from 30.63/1000 PYs to 34.42/1000 PYs, if the midpoint between baseline and follow-up was used as the time of drinking initiation. However, the Cox regression results remained similar. In future, more follow-up should be done and more details in the initiation time should be collected.

In conclusion, alcohol drinking behaviour remained relatively stable overall in Chinese community population, but the prevalence of excessive alcohol drinking significantly increased among women. Also, there was a high incidence of alcohol drinking in this study population, and adults who were male, non-Han Chinese, living in urban areas, employed, smoking or without a history of chronic diseases should be targeted as the population at risk. Therefore, the interventions for the prevention and control of alcohol consumption should be urgently developed and implemented in the Chinese communities, especially in the youth.

**Acknowledgements** We would like to thank all participants enrolled in this cohort study and all the health workers of the Guizhou Province Center for Disease Control and Prevention for contributing to this study.

**Contributors** BZ—conceptualisation, methodology, software, formal analysis, data curation, writing (original draft), visualisation. JZ—investigation, writing (review and editing), supervision. YC—software, data curation. KX—supervision. YWu—investigation. YWang—investigation. NW—supervision. TL—investigation, resources, data curation, supervision, project administration, funding acquisition. CF—conceptualisation, methodology, validation, writing (review and editing), supervision, project administration. All authors have read and agreed to the published version of the manuscript. The scientific guarantors of this publication are TL and CF.

**Funding** This work was supported by Guizhou Province Science and Technology Support Program (Qiankehe (2018)2819).

**Competing interests** None declared.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**Patient consent for publication** Not required.

**Ethics approval** This study involves human participants and was approved by the Institutional Review Board of Guizhou Province Center for Disease Control and Prevention (No. S2017-02). At the time of enrolment, all subjects provided written informed consent.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** Data are available upon reasonable request.

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