

BMJ Open Factors associated with elevated consumption of alcohol in older adults – comparison between China and Norway: the CLHLS and the HUNT Study

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ABSTRACT

Objectives The primary objective was to investigate the prevalence and factors associated with elevated alcohol consumption among older adults 65 years and above in China and Norway. The secondary objective was to compare the prevalence and factors in the two countries.

Design A secondary data analysis was conducted using two large cross-sectional studies (Chinese Longitudinal Healthy Longevity Survey data in 2008–2009 and Nord-Trøndelag Health Study data in 2006–2008).

Participants A total of 3223 (weighted) Chinese older adults and 6210 Norwegian older adults who responded drinking alcohol were included in the analysis.

Outcome measures The dependent variable was elevated alcohol consumption, which was calculated as a ratio of those with elevated drinking among current drinkers. Multivariable logistic regression was used to test the dependent variable.

Results The prevalence of elevated alcohol consumption among current drinkers for the Chinese and Norwegian samples were 78.3% (weighted) and 5.1%, respectively. Being male was related to a higher likelihood of elevated alcohol consumption in both Chinese and Norwegian samples (OR=2.729, 95% CI 2.124 to 3.506, OR=2.638, 95% CI 1.942 to 3.585). Being older, with higher levels of education and a living spouse or partner were less likely to have elevated drinking in the Chinese sample (OR=0.497, 95% CI 0.312 to 0.794, OR=0.411, 95% CI 0.260 to 0.649, OR=0.533, 95% CI 0.417 to 0.682, respectively). Among Norwegian older adults, a higher level of education was related to higher likelihood of elevated drinking (OR=1.503, 95% CI 1.092 to 2.069, OR=3.020, 95% CI 2.185 to 4.175). Living in rural areas and higher life satisfaction were related to lower likelihood of elevated drinking in the Norwegian sample (OR=0.739, 95% CI 0.554 to 0.984, OR=0.844, 95% CI 0.729 to 0.977, respectively).

Conclusions The elevated alcohol consumption patterns were strikingly different between China and Norway in regards to prevalence and socioeconomic distribution. To develop and implement culturally appropriate public health policies regarding alcohol in the future, public health policy makers and professionals need to be aware of the cultural differences and consider the demographic, social and economic characteristics of their intended population.

Strengths and limitations of this study

- This is the first study to examine the prevalence and factors associated with elevated alcohol consumption among older adults between a developed country (Norway) and a developing country (China).
- We conducted a comparative analysis using data sets from the Chinese Longitudinal Healthy Longevity Survey (CLHLS) conducted in China and the Nord-Trøndelag Health 2006–2008 (HUNT3) Study conducted in Norway. Both studies are a representative study with a large sample size.
- The sample size of elevated drinkers among Norwegian older adults was relatively small for female older adults, so we could not conduct stratified analysis by gender for China and Norway.
- The alcohol consumption measures used in CLHLS and HUNT3 were not exactly the same.
- The prevalence of elevated alcohol consumption found in the Norwegian sample maybe overestimated because the participants' response options were limited and consumption of alcohol 4–7 days a week was defined to have elevated alcohol consumption.

INTRODUCTION

Based on the clinical guidelines from the American Geriatrics Society (AGS) and the US National Institute on Alcohol Abuse and Alcoholism (NIAAA),^{1–4} elevated alcohol consumption is defined as the intake of more than one alcoholic drink per day or seven drinks per week among older adults for both genders. Elevated alcohol consumption is different from other alcohol consumption-related terms. At-risk drinking is defined as alcohol intake >40 g/day for men and >20 g/day for women by the Alcohol Use Disorders Identification Test: WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption-II.⁵ Excessive drinking is defined as alcohol intake 5+ drinks for men and 4+ drinks for women on

an occasion 1+ times in the past month by the Behavioural Risk Factor Surveillance System (US Centers for Disease Control and Prevention, 2014).⁶ Binge drinking is defined as alcohol intake >5 drinks for men and >4 drinks for women in a 2-hour period by the Substance Abuse and Mental Health Services Administration, 2016.⁷ Heavy drinking is defined as sometimes ≥ 5 drinks—roughly 60 grams of ethanol defined by the WHO Management of Substance Abuse Team.⁸ Elevated alcohol consumption has a stricter standard of alcohol intake compared with other terms.^{5–8} Elevated alcohol consumption is a significant public health problem, and is associated with many public health concerns, such as car crashes, domestic violence, antisocial behaviours, neuropsychological impairment, poor medication adherence, physical limitations and psychiatric comorbidity.^{9–13} In addition, elevated alcohol consumption increases mortality, morbidity and healthcare costs.⁸ The prevalence of elevated alcohol consumption among middle-aged and older adults ranged from 2.3% to 21.5% due to difference in age groups, ethnicity, countries, cultures, sampling strategies and study periods.^{3 9–18} Being unmarried, younger and male, less educated, tobacco smoking, gender inequalities in society and alcohol advertising regulations are associated with elevated alcohol consumption.^{3 9–18} The US NIAAA recommends no more than 14 drinks per week for men and no more than 7 drinks for women.¹⁹ But for the elderly aged 65 years and over, it is recommended to limit consumption to one drink per day in both genders, on average.^{1–4} Some nations have established guidelines to avoid alcohol consumption of more than one drink per day on average among the elderly in both men and women to reduce health risks due to alcohol consumption,^{4 20} but not in Norway and China.^{21 22} So we used the guidelines from AGS and NIAAA.

Older adults have a lower tolerance and higher sensitivity to alcohol, because of physiological changes related to ageing, chronic illnesses, medications and functional impairments. As body composition continues to change with age, older adults have a smaller volume of total body water, lower lean body mass than younger adults, which can lead to a higher blood alcohol concentration from a given dose.²³ Age-related changes such as frailty, disability, malnutrition, deprivation of family role (separated, widowed), and social role and cognitive declining may augment the greater vulnerability of older adults to the effects of alcohol.^{24–27} Such situations are also a risk for elevated drinking as a coping mechanism for poor health. Alcohol consumption among older adults worsens both insomnia and breathing disturbances during sleep.²⁸ Alcoholic beverage consumption may exacerbate cognitive impairment and dementia for older adults.²⁸ Heavy alcohol use was associated with changes in brain structures, cognitive impairments and an increased risk of all types of dementia.^{29 30} Certain medications used (eg, analgesics, cardiovascular, gastrointestinal, respiratory medications and antibiotics) in older adults in combination with alcohol may cause severe adverse effects.³¹ Elevated consumption of alcohol makes older adults

vulnerable to an increased risk of harm from alcohol.⁴ For example, elevated alcohol consumption in older adults is associated with multiple chronic diseases, such as cardiovascular problems,^{32 33} diabetes, hepatic injury,^{34 35} lung disease, reduced immune response, falls and bone fractures,³⁶ cancer in several organs,³⁷ impaired brain function and dementia,³⁸ and mortality.^{37 39 40} Furthermore, there is a relation between elevated alcohol consumption and suicide and psychiatric illness, such as depression, and anxiety, but it is not always easy to tell what came first, that is, the illness or the increased alcohol consumption.⁴¹ Women have a poorer ability to metabolise alcohol than men, possibly because of gender-related differences in total fluid distribution volume, lean body mass, liver dimensions or enzyme activity that affect alcohol in the liver.⁴²

Exploring the prevalence and factors associated with elevated alcohol consumption among older adults in different countries is desirable because it provides valuable knowledge for healthcare policy makers and professionals. Given that China and Norway have different socioeconomic development levels and cultural environments, a comparative study of these two countries may provide a better understanding of the influence of socioeconomic status and culture on elevated alcohol consumption among older adults and help to identify risk factors of elevated alcohol consumption.

Socioeconomic and cultural changes may influence patterns of elevated alcohol consumption in older adults. Socioeconomic disadvantage is related to moderate drinking, binge drinking and alcohol use problems.⁴³ Elevated alcohol consumption may be higher in communities with greater social disorders (deprivation, unemployment and crime).⁴⁴ Advertising and availability of alcohol from commercial sources are associated with increased elevated alcohol consumption.⁴⁵ Beliefs and values about the impact of alcohol on health in different cultures play an important role in elevated alcohol consumption.^{46 47} China is a developing country, and its gross domestic product (GDP) per capita in 2017 was \$8827.⁴⁸ China has been undergoing rapid changes in society, including a new economic structure, rapid urbanisation and changes in sociodemographic conditions.⁴⁹ The production and availability of alcohol in China is increasing rapidly.⁸ Alcohol consumption per capita (15+) (in litres of pure alcohol) in China increased from 7.1 to 7.2 between 2010–2016.⁸ Alcohol is becoming more affordable than in previous years. Chinese older adults have many opportunities to drink, such as during festivals, celebrations, family reunions and friends' gathering. So it is expected that these changes impact the prevalence of elevated alcohol use and elevated drinking.⁵⁰ China and Norway have substantial differences in economical levels, social norms and regulations, and cultural patterns. Norway is a developed country, and has a high socioeconomic level. Its GDP per capita in 2017 was \$75 505.⁴⁸ The data from the Nord-Trøndelag Health (HUNT) Study suggest a marked change in the drinking patterns in the population in 2006–2008 (HUNT3), compared

with 1995–1997 (HUNT2) and 1984–1986 (HUNT1), with a lower proportion of older adults reporting not consuming alcohol.⁵¹ Alcohol consumption per capita (15+) (in litres of pure alcohol) in Norway decreased from 9.0 to 7.5 between 2010 and 2016. Norwegians drink at social events, on special occasions and in everyday life for relaxation. The general population has good knowledge about the health risks of elevated alcohol consumption.⁵² Chinese culture has a long history of promoting elevated alcohol consumption. Men who can take a large quantity of alcohol are perceived as masculine.^{46 47} In social gatherings, guests are expected to empty glasses of the served alcohol, in order to show respect and sincere desire to the host, senior guests or superiors, so that they can gain more trust from others.^{53 54}

The pattern of elevated consumption of alcohol is linked to regulations and rules reflecting the country's alcohol policy and the cultural norms of the society.^{55 56} China's policies on the production of alcoholic beverages, their sales and consumption are not particularly regulated compared with many developed countries.⁵⁷ The alcohol regulations in Norway is even stricter than other European and Nordic countries.⁵⁸ One of the public health strategies in Norway is to limit access to alcohol, with restricted opening hours for sale of all types of alcohol, having separate stores for sale of wine and stronger types of alcohol, high taxes on alcohol import and production, and restrictions on where, when and to whom alcohol may be served.⁵⁸ It is interesting to explore if and how elevated drinking patterns differ in these two countries, with different social contexts, for example, differences in regulations, culture and socioeconomic development.

Our previous study examined consumption of alcohol versus practising abstinence from alcohol in China and Norway,⁵⁹ and found the prevalence of those abstaining from alcohol was much higher in Chinese male and female older adults than their counterparts in Norway. Furthermore, we found that abstinence from alcohol was related to increased age, female gender and place of living as well as the perception of health and satisfaction in life in both cultures.⁵⁹ However, knowledge is scarce regarding how elevated consumption of alcohol is tied to demographic and socioeconomic factors as well as to health status and life satisfaction in older adults both in China and Norway.^{21 22 51 60}

The primary objective of the present study was to examine the prevalence and factors associated with elevated alcohol consumption among older adults 65 years and above in China and Norway. The secondary objective was to compare the prevalence and factors associated with elevated alcohol consumption in the two countries.

METHODS

Design

In this study, we performed a secondary analysis using data from two large cross-sectional studies conducted in China and Norway at approximately the same time.

Samples from each data set

The Chinese Longitudinal Healthy Longevity Survey (CLHLS) in 2008–2009 was a national survey which selected participants from 22 out of China's 31 provinces. The population in the 22 provinces represents 85% of the total population of China. The study targeted community-living and institutionalised older adults from the cities and counties. The study was conducted in 2008–2009. Based on gender and place of residence (ie, living in the same street, village, city or county) for a given centenarian, randomly selected octogenarians and nonagenarians were also sampled. This matched recruitment procedure resulted in an oversampling of the oldest old and older men. In the CLHLS, a weight of age-sex-urban/rural residence in the sample with the distribution of the total population in the sampled 22 provinces was employed to reflect the unique sampling design.^{61–63}

The participants of CLHLS were interviewed at their own home or in institutions. For those participants with disability who were not able to answer the questions, their primary family caregivers were interviewed as proxy respondents. The report refusal rate of those older adults was very low (5.1% for the 65–79 years age group, 2% for the 80+ years age group). Older adults living in institutions were excluded from this analysis. In total about 16255 community-dwelling residents aged 65 years and older were included. All participants in this study sample answered the question about consumption of alcohol. The unweighted number of older adults who were current drinkers was 2758 (1988 male and 770 female).

The HUNT Study is one of the largest health studies ever performed in Norway, and is considered fairly representative of Norway (geographically, and regarding economy, industry, sources of income, trends in work-related disability, age distribution, morbidity and cause-specific mortality).⁶⁴ HUNT3 was the third cross-sectional HUNT study which was conducted between October 2006 and June 2008. The participants were adult residents (aged 20 years and older) in the Nord-Trøndelag County. In all, 11 545 (5461 men) out of 12 255 residents (5610 men) aged 65 years and older participated and answered questions on alcohol consumption.⁶⁵ The participants were individuals who could meet at an examination station. The rate of participation in HUNT3 decreased with age, being 71% among people aged 60–69 years, 41.6% in those aged 80–89 years and 18% among the those aged 90–99 years.⁶⁶ Older adults living in institutions were not included.

Measures

The dependent variable was elevated alcohol consumption.

CLHLS had three questions about alcohol consumption. The first one was 'Do you drink alcohol at present?'. The second one was 'If you drink alcohol at the present time, what kind of alcohol do you drink?'. There were six options: strong liquor, weak liquor, grape wine, rice wine, beer and others. We treated 'others' as a missing

value. The third question about alcohol consumption was 'If you drink alcohol at the present time, how much alcohol per day on average do you drink?'. The unit of alcohol was a Chinese unit of weight called 'Liang' (50 g). Level of alcohol consumption was calculated as drinks of alcohol per day, based on the beverage type and amount, assuming the following alcohol content by volume (v/v) typically seen in China: strong liquor 53%, weak liquor 38%, grape wine 12%, rice wine 15%, and beer 4%.⁶⁷ The participants were allowed to report only one beverage type for a typical drinking day. A previous study conducted in China showed that over 95% of drinkers consumed a single beverage type.⁶⁸ According to the recommendation of the AGS Clinical Guidelines for Alcohol Use Disorders in Older Adults,¹ elevated alcohol consumption was defined as, on average, more than one drink per day, or more than seven drinks per week. A standard drink was equal to 14.0 grams (0.6 ounces) of pure alcohol (17.744 mL) according to the criterion of Centres for Disease Control and Prevention in USA.⁶⁹

HUNT3 had a question about frequency of consumption of alcohol⁵⁹ and elevated consumption of alcohol was defined as drinking 4–7 days a week.⁶⁵ Contrary to the *CLHLS*, only frequency of alcohol consumption was available. Thus, it is possible that this definition may include participants drinking less and more than seven drinks in a week. Thus, this definition is not equivalent to the definition of elevated alcohol consumption given by the AGS Clinical Guidelines for Alcohol Use Disorders in Older Adults.¹

Sociodemographic information such as age at the time of survey completion, gender, education level, marital status (living with spouse or partner vs not) and residence (rural vs urban living) was collected in both studies. *CLHLS* had years of schooling as a continuous variable on education. *HUNT3* only had education as a categorical variable, not a continuous one. We recoded the years of schooling in *CLHLS* into a categorical variable in order to compare with *HUNT3*. The coding was as follows: Illiteracy=0 years of schooling; elementary school and middle school=1–9 years of schooling; high school=10–12 years of schooling; and college and university=more than 12 years of schooling. *CLHLS* had illiterate participants, but *HUNT3* didn't have such an education category. Each nation used their own definitions of rural and urban areas.^{70 71} Urban and rural areas in the Chinese study were self-reported by the participants according to a strictly enforced residential permit system in China.⁶² Rural and urban areas in the Norwegian study were self-reported by the responders and described in previous studies.^{70 72}

Perceptions of general health was assessed by one self-reported question. The Chinese overall health status question 'How do you rate your health at present?' had five response categories ranging from 1 (*very good*) to 5 (*very poor*). This item had been used in previous Chinese studies.^{62 73} The Norwegian general health item, 'How is your health at the moment?' had four response categories ranging from 1 (*very good*) to 4 (*very poor*). The item has

been used in several Norwegian studies.^{70 72} We reversed the coding of overall health from both the surveys so that a higher score reflected a better health status.

Life satisfaction was assessed with one item in each data set. The question in the Chinese survey asked 'How do you rate your life at present?' with five response categories that ranged from 1 (*very good*) to 5 (*very poor*). The item of life in *CLHLS* was about satisfaction, not economic status. The word 'poor' here meant unsatisfactory, but not poverty. This item had been used in previous Chinese studies.^{74 75} The Norwegian item, 'How do you think about your present life situation?' with seven response categories ranged from 1 (*extremely satisfied*) to 7 (*extremely dissatisfied*). This item has been used in several Norwegian studies, both in-hospital samples and population-based studies.^{62 70 76 77} Therefore we believe that the two questions about life satisfaction are equivalent. We reversed the coding of this item on both surveys so that a higher score reflected better satisfaction with life.

Statistical analysis

The percentage of people with elevated alcohol consumption in the Chinese and Norwegian samples was a ratio of those with elevated drinking out of all current drinkers. Multivariable logistic regression (the Enter method) was used to test the dependent variable (elevated alcohol consumption coded as 1 vs non-elevated alcohol consumption as 0). The explanatory variables with a possible relationship to elevated alcohol consumption were gender, age, level of education, marital status (living or not living with spouse or partner), living in rural (vs urban) areas, self-rated overall health and life satisfaction. We conducted univariable logistic regression analyses first. We then included those variables in the multivariable logistic regression analyses which were significantly associated with the dependent variable ($p < 0.05$) in either the Chinese or the Norwegian sample. ORs and 95% CIs are reported. In *CLHLS*, there was a category of 'unable to answer' for self-rated overall health and life satisfaction. We treated 'unable to answer' as a missing value. The *CLHLS* and *HUNT3* samples were analysed using SAS V.9.3 (SAS Institute, Cary, North Carolina, USA) and SPSS V.22.0 (SPSS, Chicago, Illinois, USA), respectively. The significance level was set at $p < 0.05$.

Patient and public involvement

Patients and the public were not involved. Participants were not involved in developing the research questions or planning the study.

RESULTS

The numbers of Chinese older adults and Norwegian older adults who responded being current drinkers were 3223 (weighted) and 6210, respectively. The prevalence of elevated alcohol consumption among current drinkers for the Chinese and Norwegian samples was 78.3% (weighted) and 5.1%, respectively. The prevalence of

Table 1 The prevalence of elevated alcohol consumption among those who drink alcohol in the Chinese CLHLS (2008–2009) and Norwegian HUNT3 (2006–2008) Study of persons 65 years and older

	China (weighted)				Norway					
	Total	Elevated consumption of alcohol			Total	Elevated consumption of alcohol				
	n	PP (%)	95% CI		n	PP (%)	95% CI			
Total sample	3223	2523	78.3	76.9 to 79.7		6210	317	5.1	4.6 to 5.6	
Gender										
Women	600	400	66.7	62.9 to 70.5		2641	67	2.5	2.0 to 3.2	
Men	2623	2123	80.9	79.4 to 82.4		3569	250	7.0	6.2 to 7.9	
Age, years										
65–74	2177	1742	80.0	78.3 to 81.7		4365	240	5.5	4.9 to 6.22	
75–84	910	682	74.9	72.1 to 77.7		1643	72	4.4	3.5 to 5.5	
85+	136	99	72.8	64.0 to 81.6		202	5	2.5	1.1 to 5.7	
Achieved level of education in*										
Illiteracy	893	704	78.8	76.1 to 81.5		–				
Elementary school and middle school	2024	1600	79.1	77.3 to 80.8		2607	75	2.9	2.3 to 3.6	
High school	185	138	74.6	68.3 to 80.9		1888	96	5.1	4.2 to 6.2	
College and university	106	68	64.2	55.1 to 73.3		1043	103	9.88	8.2 to 11.9	
Living in†										
Urban areas	1207	885	73.3	70.8 to 75.8		3984	226	5.7	5.0 to 6.4	
Rural areas	2016	1638	81.3	79.6 to 83.0		2138	85	4.0	3.2 to 4.9	
Marital status‡										
No living spouse or partner	982	813	82.8	80.4 to 85.2		1825	81	4.4	3.6 to 5.5	
Living spouse or partner	2241	1710	76.3	74.5 to 78.1		4383	236	5.4	4.8 to 6.1	
Overall health status										
Poor	347	278	80.1	75.9 to 84.3		2043	95	4.7	3.8 to 5.7	
Life satisfaction										
Poor	145	131	90.3	85.5 to 95.1		67	10	14.9	8.3 to 25.4	

Elevated alcohol consumption in China was defined as, on average, more than one drink per day, or more than seven drinks per week. A standard drink was equal to 14.0 grams (0.6 ounces) of pure alcohol (17.744 mL) according to the Centres for Disease Control and Prevention in USA criterion.

Elevated alcohol consumption in Norway was defined as consuming alcohol 4–7 days a week.

*Numbers do not sum up to 3223 and 6210 in the CLHLS and HUNT3 Study, respectively, because of missing information.

†Numbers do not sum up to 6210 in the HUNT3 Study because of missing information.

CLHLS, Chinese Longitudinal Healthy Longevity Survey; HUNT3, Nord-Trøndelag Health (2006–2008); PP, proportion.

elevated alcohol consumption by gender, age, sociodemographic conditions, perceived health and life satisfaction for both samples is given in [table 1](#).

Findings from logistic regression analyses on factors associated with elevated alcohol consumption are shown in [table 2](#). Both for Chinese and Norwegian samples, men were more likely to have elevated alcohol consumption than women (OR=2.729, 95% CI 2.124 to 3.506; OR=2.638, 95% CI 1.942 to 3.585, respectively). Chinese participants who were aged 85+ years were less likely to have elevated alcohol consumption than those aged 65–74 years (OR=0.497, 95% CI 0.312 to 0.794). There was no significant difference in elevated drinking patterns between participants aged 75–84 years and those aged 65–74 years in the Chinese samples. No statistically

significant difference was found across different age groups from the Norwegian sample. For those who completed college and university education, Chinese older adults were less likely to have elevated drinking than those who completed elementary school and middle school (OR=0.411, 95% CI 0.260 to 0.649). However, for Norwegian older adults, individuals with high school or college and university education were more likely to have elevated drinking than those with elementary school and middle school education (OR=1.503, 95% CI 1.092 to 2.069; OR=3.020, 95% CI 2.185 to 4.175, respectively). Norwegian older adults living in rural areas were less likely to have elevated drinking than those living in urban areas (OR=0.739, 95% CI 0.554 to 0.984), but there was no significant difference of elevated drinking between

Table 2 ORs and 95% CIs for elevated alcohol consumption (vs non-elevated alcohol consumption) among person 65 years and older in the Chinese CLHLS and Norwegian HUNT3 Study samples

Variables	China (weighted)						Norway					
	Univariable analyses			Multivariable analyses			Univariable analyses			Multivariable analyses		
	P values	OR	95% CI	P values	OR	95% CI	P values	OR	95% CI	P values	OR	95% CI
Gender, male	<0.001	2.317	1.861 to 2.885	<0.001	2.729	2.124 to 3.506	<0.001	2.894	2.199 to 3.808	<0.001	2.638	1.942 to 3.585
Age, years												
65–74	1	Ref	Ref	1	Ref	Ref	1	Ref	Ref	1	Ref	Ref
75–84	0.072	0.822	0.664 to 1.017	0.072	0.810	0.645 to 1.019	0.083	0.788	0.602 to 1.032	0.304	0.853	0.630 to 1.155
85+	0.032	0.624	0.405 to 0.960	0.003	0.497	0.312 to 0.794	0.070	0.436	0.178 to 1.070	0.195	0.512	0.186 to 1.409
Achieved level of education												
Illiteracy	0.277	0.886	0.712 to 1.102	0.260	1.153	0.900 to 1.478	–					
Elementary school and middle school	1	Ref	Ref	1	Ref	Ref	1	Ref	Ref	1	Ref	Ref
High school	0.637	0.902	0.589 to 1.383	0.638	0.900	0.581 to 1.394	<0.001	1.809	1.329 to 2.461	0.012	1.503	1.092 to 2.069
College and university	<0.001	0.388	0.250 to 0.601	<0.001	0.411	0.260 to 0.649	<0.001	3.699	2.722 to 5.027	<0.001	3.020	2.185 to 4.175
Living in												
Urban areas	1	Ref	Ref	1	Ref	Ref	1	Ref	Ref	1	Ref	Ref
Rural areas	0.001	1.390	1.143 to 1.691	0.258	1.129	0.915 to 1.393	0.004	0.688	0.533 to 0.889	0.038	0.739	0.554 to 0.984
Marital status												
No living spouse or partner	1	Ref	Ref	1	Ref	Ref	1	Ref	Ref	1	Ref	Ref
Living spouse or partner	0.001	0.692	0.555 to 0.863	<0.001	0.533	0.417 to 0.682	0.123	1.225	0.946 to 1.587	0.856	1.029	0.753 to 1.407
Overall health status	0.964	0.997	0.895 to 1.112	0.647	1.030	0.908 to 1.169	0.124	1.155	0.961 to 1.388	0.095	1.212	0.967 to 1.519
Life satisfaction	0.186	0.919	0.810 to 1.042	0.561	0.958	0.829 to 1.107	0.041	0.885	0.787 to 0.995	0.023	0.844	0.729 to 0.977
Adj R ² %				0.043							7.2	
–2 Log likelihood				2552.300							1969.665	

Owing to missing information the number of participants in multivariable analyses of older adults aged 65+ years was 2991 (weighted, in the CLHLS) and 5275 (in the HUNT3 Study).

Bold values are statistically significant.

CLHLS, Chinese Longitudinal Healthy Longevity Survey; HUNT3, Nord-Trøndelag Health (2006–2008).

Chinese older adults resident in rural and urban areas (OR=1.129, 95% CI 0.915 to 1.393). Chinese older adults living with a spouse or partner were less likely to have elevated alcohol consumption than others (OR=0.533, 95% CI 0.417 to 0.682). However, no similar association was found in the Norwegian sample. No significant relationship was found between overall health status and elevated alcohol consumption among Chinese and Norwegian samples. Those with better life satisfaction were less likely to have elevated drinking in the Norwegian sample (OR=0.844, 95% CI 0.729 to 0.977), but no similar association was found in the Chinese sample.

DISCUSSION

This study examined and compared the prevalence and factors (ie, sociodemographic status, perceived overall health and life satisfaction) that were associated with elevated alcohol consumption among older adults in China and Norway. The findings were quite different in the two countries.

In the previous study we found that the prevalence of current drinkers among Norwegian older adults was higher than that among Chinese older adults.⁵⁹ However, the present study found that the prevalence of elevated drinking among current drinkers in Chinese older adults was much higher than that in Norwegian older adults. We assume that the differences in prevalence of elevated alcohol consumption between China and Norway may be partially explained by different cultures between these two countries. In China, people often drink at social events such as festivals, weddings and business interactions.⁷⁸ Being a host, showing hospitality is often presented by taking a large quantity of alcohol. As a guest, drinking up the bottles or cups of alcohol shows respect to the host. Traditionally, the Chinese like to play drinking games to persuade the others to drink more alcohol. In some regions of China, taking excessive alcohol is a bridge of communication and it is helpful to construct friendship and collaboration. There is an old Chinese Saying: 'A thousand cups of alcohol is not too much when bosom friends meet'. Individuals should never refuse to participate in a toast, as that could be interpreted as being impolite.⁵³ It is believed that a good meal is not complete without a few glasses of alcohol. Some older adults drink with their meal every day. Drinking in China is about pleasure, and about respect, self-affirmation, friendship and the perpetuation of traditions. In Norway and other Western countries, alcohol consumption is tied to celebration and recreation.⁷⁹ Norwegians enjoy drinking and communication with friends or families, but they do not like to persuade others to drink at social events.

Moreover, the difference of preferred types of alcoholic beverages may partially explain the significant difference in elevated alcohol consumption between China and Norway, although this information was not available in the surveys used in this study. China has a 4000-year history of alcohol production. Chinese spirits are made of

sorghum, corn, wheat and rice, and regarded as the spirit of cereals. Many Chinese like spirits more than beer and grape wine.^{54 80} Norwegians drink beer and wine more often rather than spirits. According to a WHO report, from the 1960s to 2015, recorded alcohol per capita (aged 15+ years) consumption of spirits was more rapidly rising than those of beer and wine, and the levels of spirits were higher than those of beer and wine in China.⁸ In Norway, for the same time period, recorded alcohol per capita (aged 15+ years) consumption of beer and wine was increasing, while that of spirits was decreasing, and the levels of beer and wine were higher than those of spirits.⁸ Spirits often contain higher levels of pure alcohol than grape wine and beer.

The price of alcoholic beverages could also contribute to elevated drinking patterns. In the past two decades, Chinese alcohol production and consumption has increased significantly. The price of alcoholic beverages is relatively cheap, and home-made alcoholic beverages are popular in South China, so people can access them easily.⁸¹ In Norway, alcoholic beverages are quite expensive and access is restricted.

Different public health strategies are contributors to elevated drinking patterns in each culture. In China, there isn't any legislation or policy about decreasing alcohol use disorders and limiting access to alcohol among older adults. China has not set up a national supervision and monitoring system for alcohol consumption and alcohol use disorders. A goal of decreasing the prevalence of elevated drinking has not been set. Screening and intervention for alcohol use disorders in primary healthcare recommended by WHO have not been conducted in China.⁸² Damage control programmes and other public health promotion programmes in Norway exist to reduce health risks from drinking and even more importantly these programmes raise public awareness against elevated drinking.⁵⁸ Furthermore in Norway, it is unlawful to advertise for alcohol and alcohol consumption under any circumstances. National monitoring systems for alcohol production, sale, consumption, and alcohol use disorders are working in Norway.⁸

The prevalence of elevated alcohol consumption among adults aged 65 years and older who were current drinkers in China was much higher than in other developed countries in addition to Norway. These countries include USA and European countries.^{3 9 14-16} It is possibly due to the reasons we discussed elsewhere. This difference may also be due to the inclusions of population, different classification standards of elevated alcohol consumption and different computing methods for prevalence. The classification standards in previous studies were 40 g pure alcohol/day for men and 20 g pure alcohol/day for women, or \geq four drinks/day for men and \geq two drinks/day for women, or \geq five drinks/day for men and \geq four drinks/day for women, which were much higher than those in our study. Previous studies explored the prevalence of elevated drinking among all populations which consisted of those drinking and not drinking. Our

study investigated the prevalence of elevated drinking among those who were current drinkers. The prevalence of elevated alcohol consumption among adults aged 65 years and older who were current drinkers in Norway was lower than that in other European countries.^{14 15} This may be explained by the much stricter regulations on alcohol production, sale, tax, access and serving in Norway than in southern European countries.⁵⁸

Furthermore, we found that men had a higher prevalence of elevated alcohol consumption than women in both countries. This finding is consistent with previous studies,^{8 50 80} and may be partially due to cultural values and norms in these countries.⁸³ In Chinese traditional culture, there are more negative attitudes towards women's drinking than men's drinking. Although women's role is changing along with rapid socioeconomic development, Chinese men have more opportunities for drinking at social interactions.⁸ In rural areas of China, men are involved with heavy labour more frequently than women; hence, men may take alcohol to relieve physical fatigue.⁸⁰ We believe that culture may play a less prominent role in gender differences in Norway,⁸³ both in rural and urban areas. In addition, the differences in tolerance to alcohol between men and women may be one of the reasons of different patterns of elevated drinking. Evidence showed that women may be more vulnerable to alcohol-related harm from a given level of alcohol use compared with men. Women have lower body weight, lower total body water content, lower level of dehydrogenase enzymes and smaller liver capacity to metabolise alcohol, which may lead to higher blood alcohol concentrations than men for the same amount of alcohol intake.⁸⁴ Compared with men, women have more age-related changes in body composition after menopause with increased body fat and decreased lean body mass. It is associated with a smaller volume of distribution of ethanol and higher peak ethanol concentration in the blood after intake of the same alcohol dose compared with men.⁸² The prevalence of drinking, binge drinking and volumes of alcohol consumption is lower in women compared with men around the world.^{8 85} Women drink less on average and engage less often in heavy episodic drinking both in China and Norway.⁸ These reasons support the fact that women are less likely to take elevated alcohol than men.

Among participants aged 65 years and over, older age was negatively associated with elevated alcohol consumption in the Chinese sample. This finding was supported by the studies conducted in USA, Denmark and UK.^{86–88} The reason may be due to changes of physical health as people get older. Older adults have a lower metabolic rate of alcohol, often suffer multiple chronic diseases or take medication, which cause high sensitivity to alcohol.^{89 90} However, there was no similar association found in the Norwegian sample. The reason may be due to the small sample size of different age groups of elevated drinking in Norway.

The direction of associations between education and elevated alcohol consumption were opposite between China and Norway. For the Chinese sample, older adults

with higher level of education had a lower likelihood of elevated alcohol consumption. Chinese older adults with higher education are likely to have more health-related knowledge and better recognition about alcohol-related harm, and they have a higher level of perceived behaviour control for elevated drinking. For the Norwegian sample, older adults with higher level of education were more likely to have elevated alcohol consumption. This finding was similar to previous studies conducted in Norway.^{91 92} Brunborg's study demonstrated that higher education was associated with a greater risk of elevated drinking, while income was weakly related to heavy drinking.⁹² Education is a strong indicator of socioeconomic status in Norwegian older adults with a welfare system. Norwegian people with higher education were more likely to afford alcohol, and more often consume alcohol in social events.^{47 93–95}

Norwegian older residents in urban areas are more likely to be elevated drinkers compared with those in rural areas after adjusting for demographic and socioeconomic differences. Rural residents in Norway have less access to alcohol due to long distance and little transportation, and religious beliefs and cultural norms may have importance.⁹⁶ However, no significant relationship between rural/urban living and elevated alcohol drinking was found in the Chinese sample. Chinese older adults who are single, divorced or widowed are more likely to be elevated drinkers than those with a living spouse or partner. A previous study has demonstrated that divorced older Chinese adults are more likely to have mood disorders (insomnia, anxiety, hostility, depression and inferiority) than those married and living together.⁹⁷ Older Chinese adults with mood disorders are more likely to consume more alcohol to be happy and excited.⁹⁸ No similar association was found in the Norwegian sample. This study found that poorer life satisfaction was related to higher likelihood of elevated alcohol consumption among Norwegian older adults. This finding was supported by previous studies.^{99 100} However, this relationship was not significant among Chinese older adults, which may indicate that socioeconomic factors included in the analysis had greater importance than life satisfaction. Cultural values influencing life satisfaction may differ to some extent due to cultural differences. Furthermore, life satisfaction may be more largely explained by socioeconomic factors in Chinese older adults than that in older adults in Nordic countries, since the Nordic countries have higher education level and economic status, better social security and insurance and higher availability of community services compared to China.¹⁰¹

Limitations

This study has several limitations. The sample size of elevated drinkers among Norwegian older adults was relatively small for female older adults, so we could not conduct stratified analysis by gender for China and Norway. The alcohol consumption measures used in CLHLS and HUNT3 were not exactly the same. In the Norwegian study only a question about frequency of consumption of alcohol was

included. The participants' response options were limited and consumption of alcohol 4–7 days a week was defined as elevated consumption of alcohol. Thus, the prevalence of elevated drinking found in the Norwegian sample may be overestimated according to this definition. Drawing a conclusion of the comparison between these two countries should be carefully considered because of the different definitions of elevated alcohol consumption. The participants of HUNT3 were individuals who could go to an examination station to participate in the survey. In this case, those with the most severe conditions and alcohol problems were expected to be underrepresented. We use the definition of elevated alcohol consumption from the clinical guidelines of AGS and the US NIAAA,^{1–4} and it is defined as the intake of more than one alcoholic drink per day or seven drinks per week. Elevated consumption means consumption above the intake of alcohol that has been recommended for older adults. The concept is different from the change of alcohol intake over time. We did not have information about the individuals' previous drinking behaviours and whether they had elevated alcohol consumption. Further studies are needed to explore the differences in trends of alcohol intake over time among older adults between China and Norway.

CONCLUSIONS

This is the first comparative study reporting the prevalence and related factors of elevated alcohol consumption among older adults in a developed country (Norway) and a developing country (China). We found that the prevalences of elevated alcohol consumption and related factors among older adults from these two countries were different. The overall prevalence of elevated alcohol consumption in China was much higher than that in Norway. The prevalence of elevated alcohol consumption among older men was higher than that among older women both in China and Norway. Being male, younger in age, with a lower level of education, and without a living spouse or partner was related to a higher likelihood of elevated alcohol consumption among Chinese older adults. Being male, with a higher level of education, living in urban areas and lower life satisfaction were related to a higher likelihood of elevated alcohol consumption among Norwegian older adults.

This study has several clinical implications. The findings suggest that, when considering elevated alcohol consumption, healthcare policy makers and professionals need to take a series of factors into account. These include demographic characteristics, socioeconomic status and economic development levels, and culture-related factors in different countries. Health education and health promotion strategies should be used to prevent elevated alcohol consumption in older adults worldwide. Especially, primary healthcare providers could focus on alcohol consumption among older adults in clinical practice and provide more information about alcohol consumption, alcohol disorders and its negative

consequences. There is a need to provide screening and intervention for elevated alcohol consumption among older adults in primary healthcare. Chinese healthcare policy makers and professionals should analyse the local context when adapting western prevention or intervention strategies to address the problem of elevated alcohol consumption.⁹⁸ The differences in the prevalence and factors associated with elevated alcohol consumption in the Chinese and Norwegian samples are so clear, that they could not be caused by methodological limitations. From this perspective the present study may form the basis of a forthcoming study designed explicitly to explore cultural differences regarding elevated alcohol consumption in a broader context or multinational design.

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REFERENCES

- Moore A. *Clinical guidelines for alcohol use disorders in older adults*. New York, 2003.
- Ioannou GN, Weiss NS, Kowdley KV. Relationship between transferrin-iron saturation, alcohol consumption, and the incidence of cirrhosis and liver cancer. *Clin Gastroenterol Hepatol* 2007;5:624–9.
- Blazer DG, Wu L-T, Li-Tzy Wu SD. The epidemiology of at-risk and binge drinking among middle-aged and elderly community adults: national survey on drug use and health. *Am J Psychiatry* 2009;166:1162–9.
- Lang I, Guralnik J, Wallace RB, et al. What level of alcohol consumption is hazardous for older people? functioning and mortality in U.S. and English national cohorts. *J Am Geriatr Soc* 2007;55:49–57.
- Babor TF, Aasland OG, Grant M, et al. Development of the alcohol use disorders identification test (audit): who Collaborative project on early detection of persons with harmful alcohol Consumption-II. *Addiction* 2006;88:791–804.
- Cunningham JK, Solomon TA, Muramoto ML. Alcohol use among Native Americans compared to whites: Examining the veracity of the 'Native American elevated alcohol consumption' belief. *Drug Alcohol Depend* 2016;160:65–75.
- Clark Goings T, Salas-Wright CP, Belgrave FZ, et al. Trends in binge drinking and alcohol abstinence among adolescents in the US, 2002–2016. *Drug Alcohol Depend* 2019;200:115–23.
- WHO, Management of Substance Abuse Team. Global status report on alcohol and health 2018, 2018. Available: /entity/substance_abuse/publications/global_alcohol_report/en/index.html
- Hu Y, Pikhart H, Malyutina S, et al. Alcohol consumption and physical functioning among middle-aged and older adults in central and eastern Europe: results from the HAPIEE study. *Age Ageing* 2015;44:84–9.
- Van Montfoort-De Rave KFG, De Weert-Van Oene GH, Beurmanjer H, et al. Late-Onset alcohol dependence: patient-reported problems. *Addict Res Theory* 2017;25:139–45.
- Blanco C, Grant J, Petry NM, et al. Prevalence and correlates of shoplifting in the United States: results from the National epidemiologic survey on alcohol and related conditions (NESARC). *Am J Psychiatry* 2008;165:905–13.
- Hasin DS, Stinson FS, Ogburn E, et al. Prevalence, correlates, disability, and comorbidity of DSM-IV alcohol abuse and dependence in the United States: results from the National epidemiologic survey on alcohol and related conditions. *Arch Gen Psychiatry* 2007;64:830–42.
- Volkert J, Schulz H, Härter M, et al. The prevalence of mental disorders in older people in Western countries - a meta-analysis. *Ageing Res Rev* 2013;12:339–53.
- Bosque-Prous M, Brugal MT, Lima KC, et al. Hazardous drinking in people aged 50 years or older: a cross-sectional picture of Europe, 2011–2013. *Int J Geriatr Psychiatry* 2017;32:817–28.
- Di Bari M, Silvestrini G, Chiarlone M, et al. Features of excessive alcohol drinking in older adults distinctively captured by behavioral and biological screening instruments. An epidemiological study. *J Clin Epidemiol* 2002;55:41–7.
- Grant BF, Chou SP, Saha TD, et al. Prevalence of 12-month alcohol use, high-risk drinking, and DSM-IV alcohol use disorder in the United States, 2001–2002 to 2012–2013: results from the National epidemiologic survey on alcohol and related conditions. *JAMA Psychiatry* 2017;74:911–23.
- Kessler RC, Berglund P, Demler O, et al. Lifetime prevalence and Age-of-Onset distributions of. *Arch Gen Psychiatry* 2005;62:593–602.
- Muñoz M, Ausín B, Santos-Olmo AB, et al. Alcohol use, abuse and dependence in an older European population: results from the MentDis_ICF65+ study. *PLoS One* 2018;13:e0196574.
- Friedmann PD, Saitz R, Gogineni A, et al. Validation of the screening strategy in the NIAAA "Physicians' Guide to Helping Patients with Alcohol Problems". *J Stud Alcohol* 2001;62:234–8.
- Moos R, Brennan P, Schutte K, et al. And late-life alcohol use problems. *Am J Public Heal* 2004;94:1985–91.
- Zhang J, Wu L. Cigarette smoking and alcohol consumption among Chinese older adults: do living arrangements matter? *Int J Environ Res Public Health* 2015;12:2411–36.
- Frydenlund R. *Eldre, Alkohol Og Legemiddelbruk. En Kunnskapsopsummering. Kompetansesentret-rus Oslo: Velferdsetaten Oslo kommune, 2012: 586.*
- Vestal RE, McGuire EA, Tobin JD, et al. Aging and ethanol metabolism. *Clin Pharmacol Ther* 1977;21:343–54.
- Byles J, Young A, Furuya H, et al. A drink to healthy aging: the association between older women's use of alcohol and their health-related quality of life. *J Am Geriatr Soc* 2006;54:1341–7.
- Shaw BA, Krause N, Liang J, et al. Age differences in long-term patterns of change in alcohol consumption among aging adults. *J Aging Health* 2011;23:207–27.
- Weiss S. Alcohol and the elderly: an overlooked phenomenon in the literature in developing countries—the Israeli case. *Drug Alcohol Rev* 1993;12:217–24.
- Buja A, Scafato E, Sergi G, et al. Alcohol consumption and metabolic syndrome in the elderly: results from the Italian longitudinal study on aging. *Eur J Clin Nutr* 2010;64:297–307.
- Dufour MC, Archer L, Gordis E. Alcohol and the elderly. *Clin Geriatr Med* 1992;8:127–42.
- Xu W, Wang H, Wan Y, et al. Alcohol consumption and dementia risk: a dose-response meta-analysis of prospective studies. *Eur J Epidemiol* 2017;32:31–42.
- Rehm J, Hasan OSM, Black SE, et al. Alcohol use and dementia: a systematic scoping review. *Alzheimers Res Ther* 2019;11:1–11.
- Ostfeld AM, Wallace RB, Glynn RJ, et al. Use of medications by persons 65 and over: data from the established populations for epidemiologic studies of the elderly. *J Gerontol* 2012;47:M137–M144.
- Bobak M, Malyutina S, Horvat P, et al. Alcohol, drinking pattern and all-cause, cardiovascular and alcohol-related mortality in Eastern Europe. *Eur J Epidemiol* 2016;31:21–30.
- Kalla A, Figueredo VM. Alcohol and cardiovascular disease in the geriatric population. *Clin Cardiol* 2017;40:444–9.
- Gao B, Batailler R. Alcoholic liver disease: pathogenesis and new therapeutic targets. *Gastroenterology* 2011;141:1572–85.
- Huang A, Chang B, Sun Y, et al. Disease spectrum of alcoholic liver disease in Beijing 302 Hospital from 2002 to 2013. *Medicine* 2017;96:e6163.
- Chatha H, Sammy I, Hickey M, et al. Falling down a flight of stairs: the impact of age and intoxication on injury pattern and severity. *Trauma* 2018;20:169–74.
- Bergmann MM, Rehm J, Klipstein-Grobusch K, et al. The association of pattern of lifetime alcohol use and cause of death in the European prospective investigation into cancer and nutrition (EPIC) study. *Int J Epidemiol* 2013;42:1772–90.
- Sabia S, Faysse A, Dumurgier J, et al. Alcohol consumption and risk of dementia: 23 year follow-up of Whitehall II cohort study. *BMJ* 2018;362.
- McCaul KA, Almeida OP, Hankey GJ, et al. Alcohol use and mortality in older men and women. *Addiction* 2010;105:1391–400.
- Strandberg TE, Strandberg AY, Salomaa VV, et al. 29-year mortality, and quality of life in men in old age. *J Gerontol A Biol Sci Med Sci* 2007;62:213–8.
- Caputo F, Vignoli T, Leggio L, et al. Alcohol use disorders in the elderly: a brief overview from epidemiology to treatment options. *Exp Gerontol* 2012;47:411–6.
- Patrick KS, Straughn AB, Minhinnett RR, et al. Influence of ethanol and gender on methylphenidate pharmacokinetics and pharmacodynamics. *Clin Pharmacol Ther* 2007;81:346–53.
- Caldwell TM, Rodgers B, Clark C, et al. Lifecourse socioeconomic predictors of midlife drinking patterns, problems and abstinence: findings from the 1958 British birth cohort study. *Drug Alcohol Depend* 2008;95:269–78.
- Bryden A, Roberts B, Petticrew M, et al. A systematic review of the influence of community level social factors on alcohol use. *Health Place* 2013;21:70–85.
- Bryden A, Roberts B, McKee M, et al. A systematic review of the influence on alcohol use of community level availability and marketing of alcohol. *Health Place* 2012;18:349–57.
- Wei H, Hao W. Alcohol policy and the public good: a Chinese view. *Addiction* 1995;90:1448–50.
- Zhang J, Wang J, Lu Y, et al. Alcohol abuse in a metropolitan City in China: a study of the prevalence and risk factors. *Addiction* 2004;99:1103–10.
- The World B. GDP per capita (current US\$), 2018. Available: <https://data.worldbank.org/indicator/NY.GDP.PCAP.CD> [Accessed 10 Dec 2018].
- Cai Y. China's new demographic reality: learning from the 2010 census. *Popul Dev Rev* 2013;39:371–96.
- Wu B, Mao Z-F, Rockett IRH, et al. Socioeconomic status and alcohol use among urban and rural residents in China. *Subst Use Misuse* 2008;43:952–66.
- Støver M, Bratberg G, Nordfjörn T, et al. Use of alcohol and prescription drugs among elderly (60+) in Norway. The HUNT study, Norway. In: *Use of alcohol and prescription drugs among elderly (60+) in Norway. The HUNT study, Norway*. HUNT forskningscenter, NTNU, 2012: 34.

52. Nordlund S. Alcohol policy, norms and drinking habits in different European countries. *J Alcohol Drug Depend* 2016;4.
53. Lionnet C. Diving into China's Drinking culture. *Chinese Women* 2006;4:80–1.
54. Jiang L, Liu S. Study on the difference between Chinese and Western drinking culture. *J North Univ China* 2010;26:33–8.
55. Kumar BN, Grøtvedt L, Meyer HE, et al. The Oslo immigrant health profile. *Rapport* 2008;(7):1–59.
56. Nordlund S. Pular norms, alcohol policy and drinking behavior. In: Anderson P, Braddick F, Reynolds JGA, eds. *Alcohol Policy Eur. Evid. from Amphor*, 2012: 24–31.
57. Tang Y-lang, Xiang X-jun, Wang X-yi, et al. Alcohol and alcohol-related harm in China: policy changes needed. *Bull World Health Organ* 2013;91:270–6.
58. Nordlund S. *Alcohol, norms and habits of drinking in European countries*. Forebygging.no, 2013.
59. Li J, Wu B, Selbæk G, et al. Factors associated with consumption of alcohol in older adults - a comparison between two cultures, China and Norway: the CLHLS and the HUNT-study. *BMC Geriatr* 2017;17:172.
60. Woo J, Ho SC, Yu ALM. Lifestyle factors and health outcomes in elderly Hong Kong Chinese aged 70 years and over. *Gerontology* 2002;48:234–40.
61. Zeng Y, Liu Y, Zhang C, et al. Data quality assessment of the Chinese Longitudinal Healthy Longevity Survey 1998, 2000, and 2002 waves. In: *Analyses of the determinants of healthy longevity*. Beijing: Peking University Press, 2004: 3–22.
62. Gu D, Dupre ME, Liu G. Characteristics of the institutionalized and community-residing oldest-old in China. *Soc Sci Med* 2007;64:871–83.
63. Zeng Y, Dudley L, Poston J, et al. *Healthy longevity in China*. Springer, 2008.
64. Krokstad S, Langhammer A, Hveem K, et al. Cohort profile: the HUNT study, Norway. *Int J Epidemiol* 2013;42:968–77.
65. Tevik K, Selbæk G, Engedal K, et al. Use of alcohol and drugs with addiction potential among older women and men in a population-based study. The Nord-Trøndelag health study 2006–2008 (HUNT3). *PLoS One* 2017;12:e0184428.
66. Langhammer A, Krokstad S, Romundstad P, et al. The HUNT study: participation is associated with survival and depends on socioeconomic status, diseases and symptoms. *BMC Med Res Methodol* 2012;12:143.
67. Millwood IY, Li L, Smith M, et al. Alcohol consumption in 0.5 million people from 10 diverse regions of China: prevalence, patterns and socio-demographic and health-related correlates. *Int J Epidemiol* 2013;42:816–27.
68. Yang L, Zhou M, Sherliker P, et al. Alcohol drinking and overall and cause-specific mortality in China: nationally representative prospective study of 220 000 men with 15 years of follow-up. *Int J Epidemiol* 2012;41:1101–13.
69. What is a standard drink in the United States? centers for disease control and prevention. Available: <https://www.cdc.gov/alcohol/faqs.htm#standard> [Accessed 28 Jul 2018].
70. Midtjell K, Midtjell K, Bjartveit K, et al. *The Nord-Trøndelag Health Survey 1984–86. Purpose, background and methods. Participation, non-participation and frequency distributions*. Health service research. Center for samfunnsmedisinsk research, 1990.
71. Kamal-chaoui L, Leman E, Rufeï Z. Urban Trends and Policy in China. *OECD Reg Dev Work Pap*. OECD Publishing, 2009: 2009/1.
72. HUNT. The health study in Nord-Trøndelag (Hunt), 2009. Available: <http://www.ntnu.no/dmf/hunt/skjema> [Accessed 20 Jan 2009].
73. Peng R, Wu B. Changes of health status and institutionalization among older adults in China. *J Aging Health* 2015;27:1223–46.
74. Zhang W, Liu G. Childlessness, psychological well-being, and life satisfaction among the elderly in China. *J Cross Cult Gerontol* 2007;22:185–203.
75. Zhu H. Unmet needs in long-term care and their associated factors among the oldest old in China. *BMC Geriatr* 2015;15:1–11.
76. Holmen J, Midtjell K, Ø K, et al. The Nord-Trøndelag health study 1995–97 (Hunt 2): objectives, contents, methods and participation. *Nor Epidemiol* 2003;13:19–32.
77. Helvik A-S, Jacobsen GW, Hallberg LR-M. Effects of impaired hearing on perceived health and life situation. *Scand J Disabil Res* 2006;8:263–77.
78. Wei H, Derson Y, Xiao S, et al. Alcohol consumption and alcohol-related problems: Chinese experience from six area samples, 1994. *Addiction* 1999;94:1467–76.
79. T. K. Older and use of drugs - elderly “preventable”? forebygging.no, 2015. Available: <http://www.forebygging.no/Artikler/2015/Eldre-og-bruk-av-rusmidler--kan-eldre-forebygges/> [Accessed 8 Jan 2016].
80. Zhou X, Su Z, Deng H, et al. A comparative survey on alcohol and tobacco use in urban and rural populations in the Huaihua district of Hunan Province, China. *Alcohol* 2006;39:87–96.
81. Cochran J, Chen H, Conigrave KM, et al. Alcohol use in China. *Alcohol Alcohol* 2003;38:537–42.
82. Milic J, Glisic M, Voortman T, et al. Menopause, ageing, and alcohol use disorders in women. *Maturitas* 2018;111:100–9.
83. Bratberg GH, C Wilsnack S, Wilsnack R, et al. Gender differences and gender convergence in alcohol use over the past three decades (1984–2008), the HUNT study, Norway. *BMC Public Health* 2016;16:723.
84. Wang C, Xue H, Wang Q, et al. Effect of drinking on all-cause mortality in women compared with men: a meta-analysis. *J Women's Heal* 2014;23:373–81.
85. Mäkelä P, Tigerstedt C, Mustonen H. The Finnish drinking culture: change and continuity in the past 40 years. *Drug Alcohol Rev* 2012;31:831–40.
86. Bjørk C, Thygesen LC, Vinther-Larsen M, et al. Time trends in heavy drinking among middle-aged and older adults in Denmark. *Alcohol Clin Exp Res* 2008;32:120–7.
87. Merrick EL, Horgan CM, Hodgkin D, et al. Unhealthy drinking patterns in older adults: prevalence and associated characteristics. *J Am Geriatr Soc* 2008;56:214–23.
88. Moore AA, Gould R, Reuben DB, et al. Longitudinal patterns and predictors of alcohol consumption in the United States. *Am J Public Health* 2005;95:458–64.
89. NIH_National_Institute_on_Aging. Alcohol use in older people, 2015. Available: <https://www.nia.nih.gov/health/publication/alcohol-use-older-people> [Accessed 1 Jan 2016].
90. NIHSeniorHealth. Alcohol Use and Older Adults - Alcohol and Aging, 2015. Available: <http://nihseniorhealth.gov/alcoholuse/alcoholandaging/01.html> [Accessed 1 Jan 2016].
91. Nordfjærn T, Brunborg GS. Associations between human values and alcohol consumption among Norwegians in the second half of life. *Subst Use Misuse* 2015;50:1284–93.
92. Brunborg GS. Positive and negative Affectivity as risk factors for heavy drinking in the second half of life: a prospective cohort study. *Addiction* 2016;142.
93. Hajat S, Haines A, Bulpitt C, et al. Patterns and determinants of alcohol consumption in people aged 75 years and older: results from the MRC trial of assessment and management of older people in the community. *Age Ageing* 2004;33:170–7.
94. Rao R, Schofield P, Ashworth M. Alcohol use, socioeconomic deprivation and ethnicity in older people. *BMJ Open* 2015;5:e007525.
95. Weyerer S, Schäufele M, Eifflaender-Gorfer S, et al. At-Risk alcohol drinking in primary care patients aged 75 years and older. *Int J Geriatr Psychiatry* 2009;24:1376–85.
96. Booth BM, Curran GM. Variations in drinking patterns in the rural South: joint effects of race, gender, and rural residence. *Am J Drug Alcohol Abuse* 2006;32:561–8.
97. Tseng T-J, Wu Y-S, Tang J-H, et al. Association between health behaviors and mood disorders among the elderly: a community-based cohort study. *BMC Geriatr* 2019;19:60.
98. Cheng HG, Phillips MR, Zhang Y, et al. Relationship of drinking motives with alcohol consumption and alcohol-related problems identified in a representative community-based study from Ningxia, China. *Addict Behav* 2017;74:156–61.
99. Fergusson DM, McLeod GFH, Horwood LJ, et al. Life satisfaction and mental health problems (18 to 35 years). *Psychol Med* 2015;45:2427–36.
100. LIU J. Research on the Elderly's Life Satisfaction and the Influence Factors-Analysis Based on National Baseline Data of China Health and Retirement Longitudinal Study (CHARLS). *Sci Res Aging* 2015;3:69–78.
101. ST N, Tey NP, Asadullah MN. What matters for life satisfaction among the oldest-old? Evidence from China. *PLoS One* 2017;12:1–16.