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Alcohol Use and Policy Responses in Modern China:  
New Developments in a Changing Society

By

Wei-Mien Christine Lou

A dissertation submitted in partial satisfaction of the  
requirements for the degree of

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of the

University of California, Berkeley

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## Abstract

### Alcohol Use and Policy Responses in Modern China: New Developments in a Changing Society

By

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Doctor of Philosophy in Social Welfare

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Excessive alcohol consumption is a worldwide social problem that has greatly contributed to the global burden of disease, disability and death. Overall volume of alcohol consumption and prevalence of alcohol-related problems in China have remained relatively low in comparison to many western countries until recent years. Since the liberal economic reforms of the early 1980s, China has witnessed an alarmingly increasing rate of alcohol consumption, and as a result, increasing incidence of alcohol-related injuries and morbidity. However, comprehensive alcohol policy and public health infrastructure to address the problems associated with these changes have not yet been established. Using data from the China Health and Nutrition Survey, this dissertation - comprised of three papers - utilizes quantitative methods to examine alcohol consumption behaviors in China, in order to identify alcohol policies and interventions that are both applicable to and appropriate for the Chinese context and to recommend next steps for alcohol control policy and intervention areas in China. The first paper explores the socio-demographic and other factors that are associated with alcohol consumption behaviors in order to identify populations that are at risk for problem alcohol use and that may be targeted for prevention/public health education programs. The second paper establishes evidence regarding alcohol consumption behaviors and its association with community-level alcohol access characteristics, such as proximity of alcohol outlets and price of different types of alcohol. The third examines the association between alcohol consumption and healthcare utilization, in order to identify health policy needs for persons at risk for the development of costly chronic diseases. The three principal conclusions from the three papers are: (1) there is strong evidence of a closing gender gap in problematic alcohol consumption behaviors between men and women - although men are still more likely to consume more alcohol and be frequent and heavy drinkers than women, alcohol consumption levels and rates of heavy drinking among women are significantly increasing; (2) absence of alcohol vendor availability is associated with decreased alcohol consumption, and cost of beer and aged liquor is inversely associated amount of alcohol consumed and heavy drinking; and (3) problematic drinkers in China appear to under-utilize preventive healthcare services and possibly formal medical care in general.

## **Dedication**

To my grandmother, Juei-Chih Hsian, and my grandfather, Chun-Ting Hsian, who made every sacrifice so I could be here today.

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## Dissertation Introduction

Excessive alcohol consumption is a worldwide social problem that has greatly contributed to the global burden of disease, disability and death (Degenhardt et al., 2008; Rehm et al., 2009; Room, Babor, & Rehm, 2005; WHO, 2014). As a causal factor for more than 60 types of diseases and injuries and representing the third highest risk factor for disease and disability, alcohol consumption results in 2.5 million or almost 4% of global deaths each year, more than those caused by HIV/AIDS, violence, or tuberculosis (WHO, 2014). Although alcohol beverages have been consumed for millennia in China as part of traditional celebrations, hospitality, medicinal practices, and religious rituals, overall volume of alcohol consumption and prevalence of alcohol-related problems have remained relatively low in comparison to many western countries until recent years (Cochrane, Chen, Conigrave, & Hao, 2003; Hao, Chen, & Su 2005). Since the liberal economic reforms of the early 1980s, which launched an era of increasing urbanization, westernization, and economic and social change, China has witnessed an alarmingly increasing rate of alcohol consumption, and as a result, increasing incidence of alcohol-related injuries and morbidity (Cochrane et al., 2003; Hao, Derson, Shuiyuan, Lingjiang, & Yalin, 1999; Hao et al., 2004; Hao et al., 2005; H. Zhang et al., 2004; J. Zhang, Wang, Lu, Qiu, & Fang, 2004; J. Zhang, Casswell, & Cai, 2008).

In part due to the fairly short period of time during which these dramatic shifts in Chinese drinking behavior occurred, comprehensive alcohol policy and public health infrastructure to address the problems associated with these changes have not yet been established. Given the personal, social, and economic costs associated with problematic alcohol consumption and its consequences, the Chinese government must begin to develop and adopt alcohol policies and interventions to protect the welfare and health of its citizens. While China may look to alcohol policies and interventions currently in place in other countries to help inform development of its own policies and interventions, it is unclear if these policies and interventions primarily developed in Western countries will be applicable to the Chinese context and conditions. Moreover, policies that are not congruent with Chinese culture and context are likely to be rejected by the Chinese public (Newman, 2002).

This dissertation uses a three-paper model to examine alcohol consumption behaviors in China, in order to identify alcohol policies and interventions that are both applicable to and appropriate for the Chinese context, and to recommend next steps for alcohol control policy and intervention areas in China. The main goal of the first paper is to determine the factors that are associated with alcohol consumption behaviors in order to identify populations that are at risk for problem alcohol use and that may be targeted for prevention/public health education programs. The main goal of the second paper is to establish evidence regarding alcohol consumption behaviors and its association with community-level alcohol access characteristics, such as proximity of alcohol outlets and price of different types of alcohol. The primary goal of the third paper is to examine the association between alcohol consumption and healthcare utilization, in order to determine if the tendency for under-utilization of healthcare services among drinkers, which has been found in Western-based research, also exists in China. In order to achieve these goals, this study employs quantitative analysis methods to accomplish the following specific aims:

- (1) To determine individual-level factors associated with alcohol use (Paper 1)
- (2) To determine community-level factors associated with alcohol use (Paper 2)
- (3) To examine the association between alcohol use and healthcare utilization (Paper 3)

## Background

**Cultural context of alcohol consumption in China.** Although Western literature regarding consumption of alcohol by the Chinese and Asians in general suggest that alcohol use is not pervasive among Asians (see Caetano, Clark, & Tam, 1998; Lee, Law, Eo, & Oliver, 2002), alcohol has in fact played a central role in Chinese culture and alcohol consumption in China dates back to the Shen Nong period, approximately 7000 years ago (Cochrane et al., 2003; Hao et al., 2005). Traditionally, alcohol has been consumed as part of celebrations, hospitality, medicinal practices, and religious rituals. To this day, alcohol is considered an important aspect of Chinese culture, and is regarded as “the representation of happiness and the embodiment of auspiciousness” (Newman, 2002, p. 18).

At the same time, Chinese people have also viewed alcohol as one of the “Four Vices” or disasters, even apparently contributing to the fall of Chinese ruling dynasties and motivating early Chinese governments to implement laws to control alcohol consumption (Hao et al., 2005; Newman, 2002). For example, alcohol control policies, such as taxation, were imposed under Emperor Yu (2205-2198 BC) and the Han Dynasty (220-206 BC) (Newman, 2002). Additionally, Chinese social norms and cultural constraints have tempered the volume of alcohol consumption in the past (Cochrane et al., 2003; Hao et al., 2005). Newman (2002, p. 18-19) notes a variety of reasons for the historically lower consumption of alcohol among the Chinese population, including the following: (1) strong familial and communal influence shaped behaviors, including those that might bring shame upon the family unit; (2) relatedly, a sense of “situation-centeredness” among Chinese that contributed to lower likelihood of reckless behavior in social settings in order to avoid embarrassment and “losing face,” or hurting one’s own or family’s reputations; (3) a history of Confucian and Taoist philosophies which emphasized moderation; (4) the ceremony associated with drinking and eating meals, which dictated when drinking occurs and also slows absorption of alcohol; (5) lack of Western-style bars, along with infrequency of banquets and other drinking occasions; and (6) for many Chinese, especially during the austerity of the Maoist Communist era, economic conditions that restricted the use of alcohol to special occasions. Additionally, as in many traditional societies, Chinese women were less likely to consume alcohol, since drinking was associated with displays of masculinity and male camaraderie, and female drinking was viewed as a threat to a society’s moral order (Holmila & Raitasalo, 2005).

**Current prevalence of alcohol consumption and alcohol-related problems in China.** A growing body of research indicates that alcohol consumption in China has sharply increased in recent years (Cochrane et al., 2003; Hao et al., 1999; Hao et al., 2004; Hao et al., 2005). According to the World Health Organization (2014), there has been an increase of per capita adult alcohol consumption, measured in litres of pure alcohol, from 1.03 litres in 1970 to 6.7 litres in 2010, a more than six-fold increase. Among current drinkers, per capita alcohol consumption was 15.1 litres of pure alcohol in 2010. A 2007 national survey of drinking behaviors among men and women aged 15-69 in China showed that 55.6% of men and 15% of women reported current drinking (Li et al., 2011). Among these current drinkers, 62.7% of men and 51% of women reported excessive drinking, or consuming more than 25 grams of pure alcohol for men and 15 grams of pure alcohol for women per drinking day. A subgroup of excessive drinking, binge drinking, or drinking more than 50g of pure alcohol for men and 40 grams of pure alcohol for women on any day, was reported by 57.3% of men and 26.6% of



women. A separate measure, frequent drinking, or drinking five to seven days per week, was reported by 25.7% of men and 26.7% of women. A more recent study, conducted among men and women aged 30-79 from ten urban and rural areas in China, found higher levels of current drinking, with 76% of men and 36% of women reporting drinking in the past 12 months, though this difference in finding could be due to the inclusion of different age groups in these studies (Millwood et al., 2013). Nevertheless, these studies indicate new patterns of alcohol consumption that may be attributable to increasing westernization, urbanization, and economic liberalization. In particular, the shift towards a free market economy in the 1980s opened up a vast market for the alcohol beverage industry, and commercial production has increased nine-fold, from 2.5 kg of beverage alcohol per person to 22.9 kg per person between 1978 and 1997 (Cochrane et al., 2003). Furthermore, industrialization and economic growth have decreased the price of alcohol relative to disposable income (Centre for Social and Health Outcomes Research and Evaluation, 2006).

Concomitant with alcohol consumption increases, alcohol use disorders and alcohol-related problems have also increased (Cochrane et al., 2003; Hao et al., 1999; Hao et al., 2004; Hao et al., 2005). Lee and colleagues (2007) found that alcohol-related problems showed the most increase in all mental health (DSM-IV) disorders in metropolitan China. In a six-center survey study conducted by Hao and colleagues (1999), the prevalence of alcohol dependence among men was 6.6% and 0.1% in women, for a total of 3.4% overall prevalence. Another study found that the prevalence rate of alcohol abuse was nearly 15% among urban Chinese adults (ages 15-65) (J. Zhang et al., 2004). In addition to individual-level harms associated with increased alcohol consumption, social-level harms also present a rising concern; the World Health Organization (2014) estimates that the 2012 death rate of alcohol-attributable traffic accidents was 30.5 per 100,000 men and 22.2 per 100,000 women in China.

Traditional social acceptance towards drinking, and sometimes drinking to excess, still abound, as evidenced by popular beliefs and statements such as “drinking is good for health,” “friendship can be measured by how much you drink,” “drinking is essential in business affairs,” and “alcohol heightens sexual performance” (Tang et al., 2014, p. 274). Yet the context and conditions of China and its people has drastically changed, with an important impact on problematic alcohol consumption. Studies have indicated that, in societies that exhibit drinking patterns that are sporadic with heavy drinking occasions, alcohol consumption has more detrimental consequences on population health (Babor et al., 2010), and according to anecdotal reports, these drinking occasions during which excessive and binge drinking take place have increased in China, especially as employment-related drinking is perceived as a vital part of career advancement and a necessary behavior for success (Hao et al., 2005; “The spirit level: the Chinese are drinking more,” 2014). As China has moved from an isolated developing country with an overwhelmingly rural population to a higher-middle income country, poised as the largest market for the beverage alcohol industry, the sentiments mentioned above and the associated lack of knowledge regarding excessive alcohol consumption are likely to prove harmful to the welfare of the Chinese population in the long-term.

**Alcohol policies in China.** Currently, there are only minimal alcohol control policies in place in China (Tang et al., 2013). Policies imposing stricter penalties on drink- and drunk-driving were imposed in 2008 and 2011 (Wan, 2011; Li, Xie, Bie, & Zhang, 2012). The penalties assigned for drink-driving, defined as having a blood alcohol content (BAC) above 0.02, consists of a fine and driving license suspension for 1 to 3 months, while the penalty for

drunk-driving, defined as having a BAC above 0.08, includes fines, license revocation, and possible custodial detainment (Xiang, n.d; Li et al., 2012). Drink- and drunk-driving policies were not stringently enforced until recent years, as increases in incidence of traffic accidents and fatalities, alongside increase in the availability of automobiles, has prompted media and government attention (Hao et al., 2005; Wan, 2011; Li et al., 2012).

A second policy adopted in 1995 established regulations on alcohol advertising in the media, ranging from the banning of advertisements showing young people consuming alcohol to restricting number of television and radio alcohol advertisements permissible each day (Hao et al., 2005; Tang et al., 2013). However, many alcohol advertisers do not comply with the regulation and are not penalized. Alcohol taxation is minimal and is rated as low (<15% of retail price) compared to other countries by the World Health Organization (WHO, 2011a). A minimum drinking age law of 18 years was passed in 2006, yet is not enforced, and China is still considered not to have a minimum age law for serving and selling alcoholic beverages to minors according to the 2011 WHO alcohol profile for China (WHO, 2004; WHO, 2011a). There currently are no policies that provide environmental availability regulation, such as restricting hours and places of sale and density of alcohol outlets, and there are no restrictions on alcoholic beverages in public domains (WHO, 2011a). Finally, the Chinese government has done very little to promote public education regarding the effects of excessive alcohol consumption, despite low awareness of these alcohol-related problems among the Chinese public (“The spirit level: the Chinese are drinking more”, 2014).

**Alcohol policies in Western countries.** In contrast, there is a broad range of alcohol control policies that have been adopted and evaluated in other countries, particularly Western countries (Babor et al., 2010). For example, Sweden, which is well-known for its extensive alcohol control policy, has established policies in all of the eight WHO-defined alcohol policy areas: (1) Control of retail sale and production; (2) Off-premise sales restrictions (i.e., hours, days, and places of sale, and density of alcohol outlets); (3) Age limits for purchasing alcohol; (4) Taxation of alcoholic beverages; (5) Restrictions on advertising (complete ban across all media types); (6) Restrictions on consumption in the public domain; (7) BAC level definitions and use of random breath testing; and (8) restrictions on sponsorships of sports/youth events (WHO, 2011b).

An established body of literature has found that alcohol control policies, such as those listed above, are effective in influencing alcohol consumption patterns, which in turn reduce rate of alcohol-related problems within the United States and Europe (Aguirre-Molina & Gorman, 1996; Anderson, Chisholm, & Fuhr, 2009; Babor et al., 2010; Elder et al., 2010; Grunewald, Ponicki, & Holder, 1993; Österberg, 1992; Rehm & Greenfield, 2008). In particular, taxation on alcoholic beverages, minimum pricing, and other policies that make alcohol more expensive have been found to be particularly cost effective strategies to reduce alcohol-related harms (Anderson et al., 2009; Elder et al., 2010; Martineau, Tyner, Lorenc, Petticrew, & Lock, 2013; Nelson et al., 2013; Waagenaar, Salis, and Komro, 2009; Wagenaar, Tobler, and Komro; 2010). In a meta-analysis of 1003 estimates of 112 international studies on the effects of alcohol price and tax levels on drinking, Waagenaar, Salis, and Komro (2009) highly significant relationships ( $p < 0.001$ ) between alcohol and price measures and indices of sales or consumption of alcohol (aggregate  $r = -0.17$  for beer,  $-0.30$  for wine,  $-0.29$  for spirits, and  $-0.44$  for total alcohol), as well as heavy drinking (mean reported elasticity =  $-0.28$ , individual  $r = -0.01$ ,  $p < 0.01$ ). In a similar meta-analysis of 50 articles containing 340 estimates found among 12 databases, Wagenaar,

Tobler, and Komro (2010) found that the meta-estimates of the standard effect size of alcohol pricing and taxation controls to be  $r=0.347$  for alcohol-related disease and injury,  $r=0.222$  for violence,  $r=-0.112$  for traffic crash outcomes. In order to assess the efficacy and strength of evidence of alcohol control policies in the United States, a Delphi panel<sup>1</sup> of ten policy experts in the United States were convened and found pricing policies to be the most effective in reducing binge drinking and alcohol-impaired driving, with a rating of 4.0 and 3.8 on a five-point Likert scale, respectively (Nelson et al., 2013).

Additionally, alcohol outlet density has been associated with alcohol-related violence (Gruenewald & Remer, 2006; Livingston, Chikritz, & Room, 2007; Zhu, Gorman, & Horel, 2004), while restriction of alcohol outlet density has been found to reduce excessive alcohol consumption and some alcohol-related problems, such as alcohol-related vehicular fatalities (Campbell et al., 2009; Escobedo & Ortiz, 2002; Livingston et al., 2007). For example, in a longitudinal study examining 581 zip code areas in California, ten percent increases in the numbers of alcohol retailers and bars were related to 2.67% increases in violence rates across local areas (Gruenewald & Remer, 2006). Similarly, Zhu and colleagues (2004) found that outlet density was significantly associated with violent crime in ordinary least square regressions models in Austin, Texas ( $b=0.242$ ,  $p<0.001$ ) and San Antonio, Texas ( $b=0.383$ ,  $p<0.001$ ), after accounting for poverty and neighborhood disorder indicators such as vacant housing. In an ecologic-design based study based on data from 1990 to 1994 in New Mexico, Escobedo and Ortiz (2002) found that linear regression models showed significant association between alcohol outlet density and alcohol-related traffic accidents ( $b=2.40$ ,  $p=0.01$ ). Much of the evidence indicating a positive effect of policies regarding alcohol density has been from local area studies, however, the Delphi panel analysis mentioned previously indicated that affecting physical availability of alcohol is the second most effective after pricing policies in reducing binge drinking throughout the United States (Nelson et al., 2013). Other strategies that have been employed with limited success in Western countries are public health prevention programs, including public awareness campaigns and alcohol education (Anderson et al., 2009; Marlatt & Witkiewitz, 2002; Room, Graham, Rehm, Jernigan, & Monteiro, 2003).

### **Contribution of the Present Research**

It is unclear whether alcohol control policies that are proven effective in Western countries, as discussed by Babor and colleagues (2010) and the WHO global alcohol policy reports, will be effective within the Chinese context. Conversely, it is unknown whether policies that have demonstrated limited effectiveness in Western countries will not have greater success within China. For example, if alcohol outlet density is not found to be associated with increased alcohol use, this type of alcohol control policy may be less useful in China. This study seeks to fill this gap in knowledge by providing the empirical evidence with which to determine the types of alcohol policies and interventions that will be effective and appropriate in the Chinese context.

Furthermore, although several studies regarding alcohol consumption and socio-demographic correlates in China have emerged recently, including those included in the

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<sup>1</sup> The Delphi method provides guidance for areas of research where scientific information is controversial, incomplete or lacks precision, in order to synthesize expert opinion. Each panelist independently nominated alcohol policies that they considered to be effective for reducing excessive drinking or related harms. Panelists focused on policies that existed, or were candidates for implementation, in the U.S. Alcohol policy was defined as: “the laws, regulations and practices used to reduce excessive alcohol consumption and related harms in a society”. Policy may include the presence or absence of supporting legislation, and/or operational aspects that reflect their implementation, enforcement, or resource allocation at the state level (e.g., taxation amounts, outlet density).

literature review above (see Li et al., 2011; Millwood et al., 2013), these provide only a cross-sectional picture of drinking behaviors. The first paper of this dissertation conducts longitudinal analyses to examine trends and change over time for alcohol consumption and correlates (years 1993-2009) among Chinese men and women aged 18 and over, which identifies populations that appear to be at risk for developing problematic alcohol consumption and thus serve as targets for prevention/public education programs. Additionally, given the dearth of research examining the association of alcohol availability with alcohol consumption in China, the second paper of this dissertation can add to this knowledge base and identify whether environmental availability (physical access) and cost of alcohol can be used as levers to influence alcohol consumption in the Chinese context. Research investigating the association between alcohol consumption and healthcare utilization in China is also lacking; thus, the third paper is the first study to this researcher's knowledge that answers whether Chinese drinkers are high or low utilizers of healthcare and can identify health policy needs for persons at risk for the development of costly chronic diseases. A final strength of this research is that it uses the China Health and Nutrition Survey (CHNS) panel data, which have been and continue to be collected on a regular basis, with 2011 data regarding alcohol consumption slated to become available soon. As new data become available, these can easily be added to the analyses for ongoing examination of trends to provide the most up-to-date empirical findings.

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I enthusiastically acknowledge the institutions that permit public access to high-quality large-scale datasets, without which, this research, and research conducted by many others, would not be possible. This research uses data from China Health and Nutrition Survey (CHNS). I thank the National Institute of Nutrition and Food Safety, China Center for Disease Control and Prevention, Carolina Population Center (5 R24 HD050924), the University of North Carolina at Chapel Hill, the NIH (R01-HD30880, DK056350, R24 HD050924, and R01-HD38700) and the Fogarty International Center, NIH for financial support for the CHNS data collection and analysis files from 1989 to 2011 and future surveys, and the China-Japan Friendship Hospital, Ministry of Health for support for CHNS 2009.

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**Paper 1:**

**Is Industrialization Associated with Changes in Drinking Behaviors in China? A  
Longitudinal Study of Changing Patterns of Alcohol Consumption  
in Modern China**

## Abstract

**Purpose:** Excessive alcohol consumption is a worldwide social problem that has greatly contributed to the global burden of disease, disability and death. Since the liberal economic reforms of the 1980s, which launched an era of increasing urbanization, westernization, and changes in social and family structure, China has witnessed an alarmingly increasing rate of alcohol consumption, and increasing prevalence of alcohol-related injuries and morbidity. The present study examines longitudinal alcohol consumption trends within China to determine the factors that are associated with alcohol consumption through this period of dramatic social change, investigating these research questions: (1) How has alcohol drinking behavior changed among Chinese adults, particularly women, from 1993 to 2009?; and (2) What demographic variables predict differences in alcohol use, and how do these predictors change over time?

**Methods:** Using panel data from the China Health and Nutrition Survey, this study used four-level logistic and linear random-intercept multilevel models to examine the relationship between demographic characteristics and four measures of alcohol drinking behaviors across 1993, 2000, and 2009: current drinking, quantity of alcoholic beverages consumed per week, frequency of drinking, and heavy drinking. To examine changes across time, this study used ANOVAs and chi-square tests to test differences for these measures between 1993 and 2009.

**Results:** Rural residents were less likely to be current drinkers for all three years (OR=0.56-0.62,  $p<0.001$ ), but consumed more alcohol in 1993 ( $B=3.17$ ,  $p<0.001$ ) and 2009 ( $B=1.36$ ,  $p<0.05$ ), compared to urban residents. There were no significant differences between urban and rural residents found for quantity of alcohol consumed for 2000 and for frequent drinking across all years. Rural residents were more likely to be heavy drinkers than urban residents in 1993 (OR=2.84,  $p<0.001$ ), but no significant differences were found between urban and rural residents for heavy drinking in 2000 and 2009. Women were less likely to be current (OR=0.02,  $p<0.001$ ), frequent drinkers (OR=0.12-0.17,  $p<0.001$ ), heavy drinkers (OR=0.27-0.69,  $p<0.05$ -0.001) and consumed less alcohol than men across all three years ( $B=-5.53$ - $-7.75$ ,  $p<0.001$ ). However, odds ratios between men and women for frequent and heavy drinkers became closer one over time. Women consumed significantly more alcohol ( $\chi^2=8.00$ ,  $p<0.01$ ) and the percentage of female heavy drinkers significantly increased ( $\chi^2=16.20$ ,  $p<0.001$ ) between 1993 and 2009. Older categorical age groups demonstrated an increased likelihood of current, frequent, and heavy drinking, and increased alcohol consumption quantity compared to the youngest categorical age group across all years.

**Implications:** The mixed findings regarding urbanicity suggest the relationship between urbanization/industrialization and drinking behaviors is complex. However, this study found strong evidence of a closing gender gap in problematic alcohol consumption behaviors between men and women. Women are increasingly more likely to consume more alcohol and be heavy drinkers. Attention to women's drinking behaviors should be included in screening interventions and education efforts regarding excessive alcohol use.

The findings also suggest a cohort effect, in which younger cohorts tend to consume less and drink less frequently than older cohorts. While this may suggest that the rapid social changes in China did not negatively affect younger people's drinking behaviors, another interpretation is that problematic drinking peaks during older age. Implications are that older Chinese adults may

not be aware of the combined effects of alcohol and aging, such as decreased brain function, increased risk for dementia, and increased risk of injury. Screening for alcohol misuse among Chinese older adults may help identify individuals at risk for alcohol-related problems. Overall, policies that promote education regarding problems associated with excessive drinking should be promoted in China.



## Introduction

Excessive alcohol consumption is a worldwide social problem that has greatly contributed to the global burden of disease, disability and death (Degenhardt et al., 2008; Room, Babor, & Rehm, 2005; World Health Organization [WHO], 2014). Although alcohol beverages have been consumed for millennia in China as part of traditional and cultural practices, overall volume of alcohol consumption and prevalence of alcohol-related problems have remained relatively low in comparison to many western countries until recent years (Cochrane, Chen, Conigrave, & Hao, 2003; Hao, Chen, & Su 2005). Since the liberal economic reforms of the early 1980s, which launched an era of increasing urbanization, westernization, and changes in the traditional family structure, China has witnessed an alarmingly increasing rate of alcohol consumption, and as a result, increasing prevalence of alcohol-related injuries and morbidity (Cochrane et al., 2003; Hao, Derson, Shuiyuan, Lingjiang, & Yalin, 1999; Hao et al., 2004; Hao et al., 2005; H. Zhang et al., 2004; J. Zhang, Wang, Lu, Qiu, & Fang, 2004; J. Zhang, Casswell, & Cai, 2008).

### Alcohol Consumption in China

Although Western literature regarding consumption of alcohol by the Chinese and Asians in general suggest that alcohol use is not pervasive among Asians (see Caetano, Clark, & Tam, 1998; Lee, Law, Eo, & Oliver, 2002), alcohol has in fact played a central role in Chinese culture and alcohol consumption in China dates back to the Shen Nong period, approximately 7000 years ago (Cochrane et al., 2003; Hao et al., 2005). Traditionally, alcohol has been consumed as part of celebrations, hospitality, medicinal practices, and religious rituals; however, Chinese social norms, such as those that encourage social drinking but discourage solitary drinking, have tempered the volume of alcohol consumption in the past (Cochrane et al., 2003; Hao et al., 2005).

However, a growing body of research indicates that alcohol consumption in China have sharply increased in recent years (Cochrane et al., 2003; Hao et al., 1999; Hao et al., 2004; Hao, et al., 2005; J. Zhang, et al., 2008). According to the World Health Organization (2014), there has been an increase of per capita adult alcohol consumption, measured in litres of pure alcohol, from 1.03 litres in 1970 to 6.7 litres in 2010, a more than six-fold increase. Among current drinkers, per capita alcohol consumption was 15.1 litres of pure alcohol in 2010. A 2007 national survey of drinking behaviors among men and women aged 15-69 in China showed that 55.6% of men and 15% of women reported current drinking (Li et al., 2011). Among these current drinkers, 62.7% of men and 51% of women reported excessive drinking, or consuming more than 25 grams of pure alcohol for men and 15 grams of pure alcohol for women per drinking day. Frequent drinking, or drinking five to seven days per week, was reported by 25.7% of men and 26.7% of women. As a subgroup of excessive drinking, binge drinking, or drinking more than 50g of pure alcohol for men and 40 grams of pure alcohol for women on any day, was reported by 57.3% of men and 26.6% of women. A more recent study, conducted among men and women aged 30-79 from ten urban and rural areas in China, found higher levels of current drinking, with 76% of men and 36% of women reporting drinking in the past 12 months, though this difference in finding could be due to the inclusion of different age groups in these studies (Millwood et al., 2013). Nevertheless, these studies indicate new patterns of alcohol consumption that may be attributable to increasing westernization, urbanization, and liberalization of the economy. In particular, the shift towards a free market economy in the 1980s

opened up a vast market for the alcohol beverage industry, and commercial production has increased nine-fold from 2.5 kg to 22.9 kg of alcohol per person between 1978 and 1997 (Cochrane et al., 2003). Furthermore, industrialization and economic growth have decreased the price of alcohol relative to disposable income (Centre for Social and Health Outcomes Research and Evaluation, 2006). The World Health Organization (2014) anticipates that the highest increase of alcohol consumption globally to be in the Western Pacific Region, dominated by the Chinese population, with a per capita consumption increase of 1.5 litres of pure alcohol by 2025.

Concomitant with alcohol consumption increases, alcohol use disorders and alcohol-related problems have also increased (Cochrane et al., 2003; Hao et al., 1999; Hao et al., 2004; Hao et al., 2005). Lee and colleagues (2007) found that alcohol-related problems showed the greatest increase among all mental health (DSM-IV) disorders in metropolitan China. In a six-center survey study conducted by Hao and colleagues (1999), the prevalence of alcohol dependence among men was 6.6% and 0.1% in women, for a total of 3.4% overall prevalence. Another study found that the prevalence rate of alcohol abuse was nearly 15% among urban Chinese adults (ages 15-65) (J. Zhang et al., 2004). Xiang and colleagues (2009) found that the 12-month and lifetime prevalence of alcohol dependence among Beijing residents was 1.7 and 4.3% respectively, with increased risk of alcohol dependence among those who were older than 24 years, married, employed, and having low education levels and comorbid psychiatric disorders. Higher income was also identified as a risk factor for alcohol abuse among urban Chinese adults in Wuhan City, China (J. Zhang et al., 2004). In addition to individual-level harms associated with increased alcohol consumption, social-level harms also present a rising concern; the World Health Organization (2014) estimates that the 2012 death rate of alcohol-attributable traffic accidents was 30.5 per 100,000 men and 22.2 per 100,000 women in China.

### **Alcohol Consumption among Women**

Much of what is known regarding alcohol consumption among women comes from research based in the United States and Western Europe. Even within this body of scholarship, women have long been an understudied group in alcohol research (Angove & Fothergill, 2003; Greenfield, 2002), in part because men are generally more likely to be current drinkers, consume more alcohol, and have more alcohol-related problems and dependence symptoms (Dawson & Archer, 1992; Malin, Coakley, Kaelber, Mussch, & Holland, 1982; S. Wilsnack & R. Wilsnack, 1991). However, research indicates that women are at an increased risk for developing alcohol-related disease, such as cirrhosis, at lower consumption levels than men (Bradley, Badrinath, Bush, Boyd-Wickizer, & Anawalt, 1998; Tuyns & Pequignot, 1984). Additionally, women who drink more than two drinks a day have increased prevalence of breast cancer and all cause mortality (Bradley et al., 1998; Fuchs et al., 1995; Smith-Warner et al., 1998). Women are also more likely to report more alcohol-related psychological problems, such as depression, as compared to men (Brienza & Stein, 2002; S. Wilsnack & R. Wilsnack, 1991).

In previous research examining socio-demographic correlates of alcohol consumption in China, men reported higher drinking rates, greater amounts of alcohol consumption, and more alcohol abuse than women (Hao et al., 1999; Hao et al., 2004; Lee et al., 2009; Zhou et al., 2006). However, one study found a 10 percent increase in one-year drinking rates among women from 1993 to 2001, whereas the one-year drinking rate among men decreased by 10 percent during this time period (Hao et al., 2004). In a multinational study examining gender differences in alcohol consumption, Bond and colleagues (2010) found that higher country-level gender equality, particularly in economic participation, was associated with a decreased gender

gap in alcohol consumption. Furthermore, several studies have found that drinking behaviors and alcohol-related problems have shown a pattern of convergence between men and women in the United States, New Zealand, Finland, and other Western countries (Bloomfield, Grittner, Kramer, & Gmel, 2006; Keyes, Grant, & Hasin, 2008; McPherson, Casswell, & Pledger, 2004; Simons-Morton et al., 2009).

The purpose of this study is to examine alcohol consumption trends and patterns within China, to determine the factors that are associated with alcohol consumption and potential changes in alcohol consumption behavior through this period of dramatic social change (early 1990s to present). The main objective of this study is to examine gender differences in trends of alcohol consumption in China. Although several studies regarding alcohol consumption and gender correlates in China have emerged recently, these only provide a cross-sectional picture of drinking behaviors. Moreover, though an earlier study (see Xiang et al., 2009) examined the cross-sectional association between alcohol dependence/abuse and a wide range of socio-demographic characteristics (age, employment, education level, and marital status), the study population was limited to Beijing residents, and it could not inform regarding the larger population of alcohol users, which is much greater than those with diagnosed alcohol dependence/abuse (Zarkin, Bray, Babor, & Higgins-Biddle, 2004). Thus, this study seeks to answer following two research questions and test the following associated hypotheses:

1. Have there been changes in alcohol use (current drinking, amount consumed, frequency of drinking, and heavy drinking) among Chinese men and women from 1993 to 2009?
  - a. Both men and women will exhibit increases in alcohol use from 1993 to 2009, with increases in current drinking, amount consumed, frequency of drinking, and heavy drinking.
  - b. The magnitude of alcohol use increases will be greater for women than for men..
2. What demographic variables predict differences in alcohol use, and how do these predictors change over time?
  - a. Gender, age, marital status, employment status, education level, household income, and urban/rural location will be significant predictors of alcohol use for the total sample, as well as separately for men and women.
  - b. Gender will become less significant predictor of alcohol use in more recent years.

With rapid economic development and increasing modernization and westernization, alongside the Chinese government's promotion of gender equality, it is hypothesized that drinking behaviors among women in China will show a convergence with men's drinking behaviors. Consequently, gender is expected to become a less significant predictor of alcohol use, and women will demonstrate increases in their rates of alcohol consumption over time, as well as possibly exhibit heavier and more frequent alcohol consumption.

## Methods

### Study Sample

This research uses publicly available datasets from the China Health and Nutrition Survey (CHNS). The CHNS is an “an ongoing international collaborative project between the Carolina Population Center at the University of North Carolina at Chapel Hill and the National Institute of Nutrition and Food Safety at the Chinese Center for Disease Control and Prevention, ...designed to examine the effects of the health, nutrition, and family planning policies and programs implemented by national and local governments and to see how the social and economic transformation of Chinese society is affecting the health and nutritional status of its population” (CHNS, n.d.). The survey was first administered in 1989, with seven additional panels collected in 1991, 1993, 1997, 2000, 2004, 2006, 2009, and 2011. The most recent survey consists of seven sections which have been developed over time: household survey (including survey items pertaining to household characteristics), health services, individual survey, nutrition and physical examination, community survey, food market survey, and health and family planning facility.

The CHNS study population was drawn from nine Chinese provinces: Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Liaoning, and Shandong (see Figure 1). The study locations did not include the most interior provinces of China, which are less economically developed than the coastal and near-coastal regions, and consequently, the samples are not nationally representative (Fujita & Hu, 2001). However, the participating provinces do include northern, central, and southern provinces and are socioeconomically and demographically diverse. The CHNS research team stratified counties in the nine participating provinces by income (low, middle, and high), and a multi-stage, cluster weighted sampling process was used to randomly select 4 counties in each province. The provincial capital and a lower income city within each province were selected when possible. Within each county/city, villages, townships, and urban and suburban neighborhoods were then selected randomly. From these sampling units, twenty randomly chosen households were selected and all adults (ages 18 and over) within the households were interviewed. Beginning in 1997, new participants were recruited as replenishment samples “if a community has less than 20 households or if participants have formed a new household or separated from their family into a new housing unit in the same community” (Popkin, Du, Zhai, & Zhang, 2009, p. 1437). Also in 1997, the Liaoning province was not able to participate and the Heilongjiang province was added. In 2000 and in subsequent survey years, both Liaoning and Heilongjiang provinces were surveyed.

The survey was administered using face-to-face interviews. Typically, the interview team stayed within a community for four or more days and visited each household daily to collect data. Interviews lasted from half an hour to one hour per household for each of the days of data collection. Each household was given a gift of five to twenty dollars as an incentive. Given the complex nature of recruitment, such as replenishment samples, province dropout and return, and individual dropout and return, response rates and attrition for the survey across all study years are difficult to determine (Popkin et al, 2009). Despite this limitation, this study provides the best available longitudinal data for alcohol use in China.

This study uses data beginning with the 1993 survey wave, when consistent alcohol-related survey items were first included, and also includes the most recent survey wave available (2009) and a mid-point survey wave (2000). Data from the 2011 survey wave are currently not available for the variables of interest in this study. For the 1993 survey wave, there were 190

primary sampling units: 32 urban neighborhoods, 30 suburban neighborhoods, 32 towns (county capital city), and 96 rural villages (CHNS, n.d.). Beginning in 2000, there were 216 primary sampling units: 36 urban neighborhoods, 36 suburban neighborhoods, 36 towns and 108 villages. A total of 15,174 individuals were interviewed in 1993, a total of 17,181 individuals were interviewed in 2000, and a total of 18,917 individuals were interviewed in 2009.

Table 1 contains descriptive data regarding the socio-demographic characteristics of the general study population. Gender and urban/rural categories were approximately equally represented throughout all study years. Age categories were fairly equally distributed in 1993, but age distribution was skewed towards older age categories in 2009. Marital status appeared stable between 1993 and 2000, however, there was a sharp decrease of never married persons in 2009 due to missing data. The number of respondents that were working decreased over the three survey years, while those who reported that they were not working increased. These data also indicate educational and income level trends of increasing education attainment and growing per capita household income from 1993 to 2009.



Figure 1:

From: China Health and Nutrition Survey, n.d.

### Dependent Variables

The key dependent variables consist of the four measures of alcohol consumption: (1) current drinking, defined as drinking of any alcoholic beverage in the past year; (2) quantity of alcoholic beverages consumed per week; (3) frequency of drinking; and (4) heavy drinking. The first measure was based on the survey item, “Last year, did you drink beer or any other alcoholic beverage?”

The second measure was derived from survey items about the types of alcohol consumed (beer, wine, and liquor) and the amount of each type consumed per week. Responses were reported in units of number of bottles per week for beer, and number of liangs (50 gm) per week for wine and liquor. These units were converted to approximate standard drink sizes, defined by

the National Institute on Alcohol Abuse and Alcoholism (NIAAA, n.d.) as any drink that contains 14 grams (1.2 tablespoons) of pure alcohol, if possible. Units of wine were converted to three liangs (approximately 5 oz.), units of liquor remained as one liang (approximately 1.5 oz.), and units of beer remained as one bottle, given the limitation of this measurement unit and with the assumption that the average size of a bottle of beer is 12 oz. The units for each type of alcoholic beverage were summed to provide number of standard drinks consumed weekly.

The third measure was based on the survey question “How often do you drink beer or any alcoholic beverage,” with the following available response choices: almost every day, 3-4 times a week, once or twice a week, once or twice a month, or no more than once a month. Responses indicating drinking at least once per week or more were coded as frequent drinking, whereas responses indicating drinking twice a month or less were coded as infrequent drinking, based on categories using a modified version of Cahalan, Roizen, and Room's (1976) Quantity-Frequency Index (QF) set forth by NIAAA (2005). Specifically, NIAAA (2005) defined frequent drinking as “drinks at least once a week, and may or may not drink 5 or more drinks at a sitting less than once a week but at least once a year.”<sup>1</sup> In the absence of survey data regarding number of drinks consumed per sitting/drinking occasion, this measure could only be based on the frequency component of this definition.

The fourth measure was constructed to compare non-heavy drinkers with heavy drinkers, as defined by NIAAA (n.d.), for which responses indicating more than 7 drinks per week for women and more than 14 drinks per week for men were coded as heavy drinking.

### **Independent Variables**

The independent variables include gender, urban/ rural location, per capita household income, as well as dummy variables for age, marital status, employment status, and education level. Gender and urban/rural location are dichotomous variables. Per capita household income is a continuous variable. Per capita household income was converted to 1000 renminbi (RMB) units and transformed to the log scale in order to make the findings more interpretable and negative values were recoded to missing. Age was grouped into five categories: 18-25, 26-35, 36-45, 46-55, and 56+ years. Marital status was classified into three categories: never married, married, and divorced/separated/widowed. Employment status was classified into two categories, currently employed and not working, which included those respondents seeking work, doing housework, student, retired, and disabled/other. Education level was classified into four categories: less than primary school graduate, less than high school graduate, high school graduate and technical/ vocational school graduate, and college graduate and above. Interaction terms between survey year dummy variables and each of the independent variables were included in the model to determine significance of each of the independent variables for each of the survey years examined in this study.

### **Analysis**

In order to answer the first research question, Pearson chi-square tests were performed to determine if there were significant differences in the three dichotomous dependent variables, current drinking, frequent drinking and heavy drinking, among the three survey years for men

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<sup>1</sup> Other categories are the following: “Abstainer” defined as “never drinks, or drinks less than once a year”; “Less frequent” defined as “drinks 1 to 3 times a month, and may or may not drink 5 or more drinks, at least once a year”, and “Frequent heavy drinker” defined as “drinks at least once a week, and has 5 or more drinks at one sitting at least once per week”. <http://pubs.niaaa.nih.gov/publications/Social/Module1Epidemiology/Module1.html>

and women. For the continuous dependent variable, number of standard drinks consumed weekly, analyses of variance (ANOVA) were performed.

In order to answer the second research question, this study used a four-level logistic random intercept multilevel model for the two dichotomous dependent variables, current drinking and frequent drinking. For the continuous dependent variable, number of standard drinks consumed weekly, a three-level generalized mixed linear multilevel model was used. For both linear and logistic models, time was nested within the individual, the individual was nested within the household level, which was nested within the community level (see Monda, Gordon-Larsen, Stevens, & Popkin, 2007) for a similar analysis assessing association of urbanization with occupational activity using CHNS data). These models were selected to account for clustering of data and provide more robust confidence intervals and significance tests (Rabe-Hesketh & Skrondal, 2005). Analyses were conducted for the total sample and separately for men and women to examine gender differences, given that women may differ from men in characteristics associated with alcohol consumption behaviors. Degree of freedom tests and ANOVAs were conducted to test the categorical independent variables, which indicated the statistical significance of the categories included in the analyses. Likelihood ratio tests were conducted to test the full three-level model and the restricted one-level model. For all models, except that for females in 2009, the likelihood ratio tests indicated that the full model provided a better fit than the restricted model.

## Results

### **Hypothesis 1a: Both men and women will exhibit increases in alcohol use from 1993 to 2009, with increases in current drinking, amount consumed, frequency of drinking, and heavy drinking.**

Table 2 presents the results of Pearson chi-square tests and ANOVAs examining differences in drinking behaviors for the total sample, and men and women separately, between years 1993 and 2000, 2000 and 2009, and 1993 and 2009. For the total sample, current drinking significantly increased between 1993 and 2000, but did not significantly change between 2000 and 2009. Mean weekly alcohol consumption, frequent drinking, and heavy drinking also both increased for the total sample between 1993 and 2000, but significantly decreased from 2000 to 2009. Between the earliest study year 1993 and most recent study year 2009, there was no significant difference in current drinking, mean weekly alcohol consumption, and heavy drinking, but frequent drinking significantly decreased.

Contrary to the hypothesized expected increase for women, the prevalence of current drinking did not change significantly from 1993 to 2000 and from 2000 to 2009. Current drinking significantly decreased for women from 1993 to 2009. However, mean weekly alcohol consumption significantly increased for women from 1993 to 2000, did not significantly differ from 2000 to 2009, and exhibited an overall significant increase between 1993 and 2009. Similarly, heavy drinking among women significantly increased between 1993 and 2000 but exhibited no significant change between 2000 and 2009, with an overall significant increase between 1993 and 2009. Women exhibited a significant increase in frequency of drinking from 1993 to 2000, and a decrease in frequency of drinking from 2000 to 2009, with no significant differences in frequency of drinking from 1993 to 2009.

Current drinking among men increased significantly from 1993 to 2000, though not from 2000 to 2009, with a significant overall increase in current drinking from 1993 to 2009. Mean

weekly consumption also significantly increased for men from 1993 to 2000, though decreased from 2000 to 2009. This indicates a spike in mean weekly alcohol consumption for men from the year 1993 to 2000, with no significant changes in consumption amounts in 1993 compared to 2009. Findings regarding frequency of drinking for men show no significant changes from 1993 to 2000 and a significant decrease between from 2000 to 2009 and from 1993 and 2009. Heavy drinking among men increased between 1993 and 2000, and significantly decreased between 2000 and 2009, with no evidence of overall changes between 1993 and 2009.

**Hypothesis 1b: The magnitude of alcohol use increases will be greater for women than for men.**

Current drinking among men significantly increased, with an additional 3.7% of men reporting current drinking between 1993 and 2009, while women exhibited a significant decrease of 1.5% during this time period. Women exhibited significant increases in weekly alcohol use from 1993 to 2009, showing an increase from 2.8 to 3.8 drinks weekly, while men did not show significant changes in weekly alcohol consumption during this period, exhibiting a non-significant decrease from 9.7 drinks consumed weekly to 9.2. Among women, frequent drinking decreased by 2% between 1993 and 2009, while frequent drinking decreased at a higher percentage of 8.3% among men between 1993 and 2009. The percentage of male heavy drinkers non-significantly dropped from 19.9% to 19.2% between 1993 and 2009, while the percentage of female heavy drinkers nearly doubled, from 7.3% to 15.7%.

**Hypothesis 2a: Gender, age, marital status, employment status, education level, household income, and urban/rural location will be significant predictors of alcohol use for the total sample, and separately for men and women.**

**Current drinking.** Table 3 contains the regression analyses results examining the association between socio-demographic characteristics and current alcohol consumption for 1993, 2000, and 2009. In the analyses for the total sample, women were significantly less likely to be current drinkers than men for all three years. Higher age groups were generally associated with significantly increased likelihood of current drinking, particularly for those between the ages of 26-35, 36-45 and 46-55 years. These age groups were found to have significantly increased odds of being current drinkers compared to those aged 18-25 years for 1993 and 2000. However, only those aged 36-45 and 46-55 years were significantly more likely to be current drinkers than those aged 18-25 in 2009. Additionally, the oldest age group category, 56 years and older, did not significantly differ from the youngest age group for all three years examined. Being married also significantly increased the odds of being a current drinker compared to those who had never married for all three years, and those who were divorced, separated or widowed were significantly more likely to be current drinkers than the never married for 1993 and 2000, though these differences disappeared in 2009.

Employment status was associated with current drinking in more recent years, with non-working persons significantly less likely to be current drinkers than those currently working for 2000 and 2009. Respondents that were not working (seeking employment, homemaker, and student) and that were disabled or otherwise not currently working also were less likely to be current drinkers than the employed for at least two of the three years examined. In other words, those who were currently working were significantly more likely to be current drinkers than other categories of employment status.



Generally, the findings indicate higher education levels to be associated with current drinking, particularly in 2009. For 2009, persons with a high school or technical/vocational school degree and with college degrees or higher were associated with increased odds of current drinking compared to those who did not graduate primary school. Per capita household income was significantly associated with increased odds of current drinking for all three years. The community-level characteristic, urban/rural location, was also significantly associated with current drinking status for all three years, in that those living in rural areas were significantly less likely to be current drinkers than those living in urban areas.

The findings regarding associations between current drinking and socio-demographic characteristics for men were generally very similar to those found in the analyses including both genders. That is, for men, being never married significantly decreased the odds of being a current drinker, while those currently working and in higher age groups, except for the oldest category 56 and up, significantly increased the odds of being a current drinker. However, for men in 2009, age group had no association with current drinking except that men ages 46-55 years had significantly increased odds of being a current drinker then those ages 18-25 years. For women, age, marital status, and employment status showed no evidence of association with current drinking. Higher education level was associated with current drinking for women in 2009, though not for earlier survey years. Rural status was the only socio-demographic characteristic that was consistently associated with decreased odds of being a current drinker in comparison to urban status among women for all three years.

**Weekly alcohol consumption.** Table 4 contains the regression analyses results examining the association between socio-demographic characteristics and number of standard alcoholic drinks consumed weekly for 1993, 2000, and 2009. As might be expected from the findings from the analyses regarding current drinking, women consumed significantly less alcohol than men for all three years. Rural drinkers drank significantly more than urban drinkers, though they were less likely to be current drinkers, for all three years. Generally, there were fewer socio-demographic variables associated with consumption amount than there were associated with current drinking. Only age, with those in older age categories drinking significantly more than those aged 18-25 years, was uniformly associated with consumption amount for all three years. Marital status and education level showed no association with weekly alcohol consumption for all three years. In 1993, disabled, retired or otherwise not currently working persons consumed significantly more alcohol than employed persons, but drank significantly less in 2009.

Among men, the findings mirrored those for the analyses including both genders. Notably, older men drank significantly more than men ages 18-25 years. Men 56 years and older drank at least five more drinks per week than those ages 18-25 in 2000 and 2009. Increases in per capita household income were associated with increases in alcohol consumption among men for 1993, and rural men drank significantly more alcohol than urban men in 1993 and 2009. For women, rural/urban status was the only variable associated with alcohol consumption amounts, with rural location associated with increased alcohol consumption in 1993. There were no other significant associations between socio-demographic variables and amount of alcohol consumed for women across all three years.

**Frequency of alcohol consumption.** Table 5 contains the regression analyses results examining the association between socio-demographic characteristics and frequent drinking for

1993, 2000, and 2009. Again, women were significantly less likely to be frequent drinkers than men across all three years. Similar to findings for current drinking, older age groups were significantly more likely to be frequent drinkers, while those who were never married were significantly less likely to be frequent drinkers. Higher education levels were associated with decreased odds of being a frequent drinker; those with college degrees or higher had at least 58 percent decrease in odds of being a frequent drinker in 2009. However, increased per capita household income was associated with increased odds for frequent drinking for 1993 and 2009. No significant differences in frequent drinking were detected between urban and rural individuals across all three years

Among men, the only consistent statistically significant association with being a frequent drinker was being in an older age category. Though being married significantly increased the odds of being a frequent drinker compared to the never married in 1993 and 2009, marital status had no significant association with frequent drinking in 2000. Employment status had no association with frequency of drinking for all three years. Among women, findings of association between socio-demographic characteristics and frequent drinking were limited. In 2009, household income had a positive association with frequent drinking for women, while being college graduates or higher had a negative association with frequent drinking.

**Heavy drinking.** Table 6 contains the regression analyses results examining the association between socio-demographic characteristics and heavy drinking for 1993, 2000, and 2009. Women were significantly less likely to be heavy drinkers than men across all three years. Similar to findings for other drinking behaviors, for the total sample and for men, older age groups were significantly more likely to be heavy drinkers, with individuals aged 56 and older having more than four times the likelihood of being heavy drinkers compared to the youngest drinking group in 2009. For the total sample and for males, married persons were significantly more likely to be heavy drinkers compared to never-married persons in 1993, though this association disappeared in 2000 and 2009. Retired, disabled, and otherwise non-working persons among the total sample and men demonstrated lower odds of being heavy drinkers in 2009 compared to working persons. Increased per capita household income was associated with increased odds for heavy drinking among the total sample and men in 2009. Rural residents were more likely to be heavy drinkers compared to their urban counterparts in 1993, though no significant differences were found for latter survey years. Among women, there were no significant findings of association between socio-demographic characteristics and heavy drinking.

**Hypothesis 2b: Gender will become less significant predictors of alcohol use in more recent years.**

Gender became a less significant predictor of for frequent and heavy drinking across time, although remained flat for current drinking. Specifically, the odds ratios for heavy drinking between men and women increased from 0.27 in 1993 to 0.43 in 2000 to 0.69 in 2009. Though exhibiting slighter differences for frequent drinking, odds ratios between men and women also converged closer to one, from 0.12 in 1993 to 0.14 in 2000 to 0.17 in 2009.

## Discussion

These findings support the hypothesis that drinking patterns between men and women in China will become more similar with increasing modernization and Westernization in other social areas. Though Chinese women continued to be significantly less likely than Chinese men to be current, frequent, and heavy drinkers, and drank significantly less than men, as continues to be the pattern found in Western countries, this study shows that problematic drinking among current women drinkers, particularly heavy drinking, is increasing and provides strong evidence of a closing gender gap in drinking behaviors between men and women. Attention to women's drinking behaviors should be included in health promotion initiatives and education efforts regarding effects of excessive alcohol use, particularly the disproportionate effect of alcohol consumption on women's health. Moreover, urban women are more likely than their rural counterparts to be current drinkers, supporting earlier findings from a study conducted in Hunan (Zhou et al., 2006). Modernization may play a larger role in certain areas in China and have a greater impact on the alcohol consumption behaviors of both men and women residing in urban areas, though the findings present some evidence that urbanicity effects on alcohol consumption amounts and frequency of drinking are diminishing. Even so, both urban women and men may be likely to be vulnerable for the development of alcohol-associated problems and are important groups for which to target prevention and intervention efforts.

This study found significant association between current drinking and higher education levels among women in 2009, a pattern that has been documented in other countries, suggesting more highly educated Chinese women are less likely to be bound by traditional social norms (Ahlström, Bloomfield, & Knibbe, 2001; Bloomfield et al., 2006). However, study findings also show lower amounts of drinking among this group, indicating that, though more highly educated women are more likely to drink, they are also more likely to be moderate drinkers than less educated women. Women with lower levels of education may not be aware of the impact of heavy drinking, and information regarding problematic alcohol use should be made available to them in settings outside of formal education institutions.

Across all drinking measures for men and many for women, the findings indicate a spike in drinking in 2000, with significant increases between 1993 and 2000, and often significant decreases between 2000 and 2009. The factors related to this spike should be investigated in future research, such as whether or not these were directly related to alcohol-specific issues, or were due to other factors, such as macro-economic conditions. Specifically, in 2000, China's economic prosperity was experiencing unfettered growth, while the global economic slowdown beginning in 2008, referred to as the Great Recession, affected a sharp fall in China's GDP in 2009. Ruhm and Black (2002) found that alcohol consumption during economic downturns tends to decrease due to factors such as lower incomes, and studies conducted in the European Union and Iceland following the Great Recession found short-term reductions in alcohol consumption (Ásgeirsdóttir, Corman, Noonan, Ólafsdóttir, & Reichman, 2014; Toffolutti & Suhrcke, 2014). Data from the most recent CHNS survey year 2011 should be examined as a next research step to investigate whether or not the decline in Chinese alcohol consumption in 2009 continued.

Older and middle-aged Chinese adults are more likely to drink alcohol, consume more alcohol, and be frequent and heavy drinkers than younger Chinese adults, whereas panel studies in the United States found that, though alcohol consumption is declining more slowly among recent cohorts compared to earlier cohorts, older adults tend to drink less than younger people (Caetano, Barauh, Ramisetty-Mikler, & Emaba, 2010; Moore et al., 2005). The findings also

suggest a cohort effect in China, in which younger cohorts over time tend to consume less and drink less frequently than older cohorts. On the one hand, this rather surprising trend could indicate increasing awareness of problems associated with alcohol among younger people. Additionally, this may reflect changing drinking patterns in which younger cohorts are less likely to practice traditional frequent use of alcohol for medicinal purposes, particularly medicinal liquor which includes traditional herbs and has customarily been used as elixirs for the improvement of general health and the treatment of ailments, such as arthritis and impotence (Hao et al., 2005). However, these findings may also indicate that problematic alcohol consumption peaks in later life in China, whereas alcohol consumption typically peaks during young adulthood in Western countries (Johnstone, Leino, Ager, Ferrer, & Fillmore, 1996; Karlamangla, Zhou, Reuben, Greendale, & Moore, 2006; Kuntsche, Rehm, & Gmel, 2004). Anecdotal reports support this possibility, such as accounts that “drinking games are played by middle-aged men rather than university students” (“The spirit level: The Chinese are drinking more”, 2014). Another implication is that older Chinese adults may not be aware of the combined effects of problematic and heavy alcohol consumption and aging, such as decreased brain function, increased risk for dementia, and increased risk of injury (Mukamal et al., 2003; Sorock, Chen, Gonzalgo, & Baker, 2006). Moreover, heavy, frequent, and other problematic drinking behaviors during middle age can contribute to health problems emerging in later life, such as cognitive impairment (Anttila et al., 2004; Goldberg, Burchfiel, Reed, Wergowske, & Chiu, 1994). Targeted public health campaigns may help educate older and middle-aged Chinese adults regarding the harms associated with excessive alcohol consumption, and screening for alcohol misuse among Chinese middle-aged and older adults may help identify individuals at risk for alcohol-related problems.

Though over time there were proportionately more current drinkers among those that have never married, suggesting changing drinking behaviors among this group, married people in China were more likely to be current and frequent drinkers throughout all three years examined. This finding is also somewhat contrary to socio-demographic correlates in most Western countries in which never married people report more alcohol use than those who are married (Caetano et al., 2010). This suggests that the Chinese cultural norms that encourage social drinking and discourage solitary drinking may have some effect on drinking practices for married and never married people in China (Hao et al., 2005). Other possible contributing for the differences in drinking patterns between China and Western countries among married and single people is the context of drinking. In many Western countries, attending bars for socializing is common for single people, whereas bar culture is relatively new in China and there have traditionally been fewer socially acceptable venues for single people to drink (Treno, Alaniz, & Gruenewald, 2000). The changing context of alcohol drinking may influence drinking behaviors in the future and research should examine situational drinking within China to determine if context influences drinking patterns.

One of the limitations of this study is the amount of missing data. Particularly in survey year 2009, almost all independent and dependent variables had substantial missing data. In effect, this contributed to a very small sample size of women in the 2009 analyses, especially for frequency of drinking, and the confidence intervals are consequently very wide. Any conclusions drawn from the 2009 data need to be replicated with a larger sample size. A second limitation of this study is that statistical analysis examining patterns of drinking (combined frequency and amount) could not be performed due to very small numbers of people reporting heavy infrequent drinking and current lack of appropriate regression techniques for multi-level

analyses of categorical outcomes. Another related limitation was that the most refined alcohol consumption quantity measure asked only about quantity of alcohol consumed per week, not per drinking episode, which precludes the ability to analyze factors associated with binge drinking, defined as five or more alcoholic beverages consumed by men and four or more alcoholic beverages consumed by women per two-hour drinking episode (NIAAA, 2004). As Rehm (1998) notes, frequency only measures cannot differentiate between light, moderate, and heavy drinkers per drinking occasion nor identify variability in drinking patterns, both of which influence immediate and chronic outcomes. Future research should investigate populations at risk for problematic drinking patterns, such as heavy frequent drinking and binge drinking.

Despite these limitations, this research contributes to current knowledge about alcohol consumption behaviors in China, for both the general population and women in particular. Although Chinese women's prevalence and frequency of alcohol consumption did not increase over the course of the sixteen years included in this study, women's heavy drinking and amount of alcohol consumption has grown significantly, indicating convergence with Chinese men's alcohol consumption, perhaps due to the effects of industrialization and Westernization. Continued research regarding drinking behaviors and alcohol-related problems among Chinese women is recommended. Moreover, the Chinese government should promote public education and awareness campaigns among women and other groups identified in this research as at risk for problematic alcohol consumption, such as middle-aged and older adults. As these and alcohol policy emerges and develops within China, such as stricter enforcement of drink- and drunk- driving laws and establishment of a minimum drinking age, future research should examine the effects of these policies on drinking behaviors and the prevalence of alcohol abuse and dependence.

Table 1. General Demographic Characteristics

	% of Total N <sup>1</sup>	% of Total N <sup>1</sup>	% of Total N <sup>1</sup>
	1993 (N=15,174)	2000 (N=17,181)	2009 (N=18,917)
Gender			
Male	43.2	45.2	41.8
Female	42.3	45.2	44.0
Age, year			
18-25 y	9.7	6.5	3.8
26-35 y	12.0	11.2	6.3
36-45 y	13.2	13.1	11.7
46-55 y	8.2	11.9	12.1
56+ y	11.7	13.7	19.2
Marital status			
Never married	38.0	30.9	3.6
Married	47.5	50.1	44.2
Divorced/Separated/ Widowed	4.2	4.3	5.2
Employment status			
Working	52.6	50.3	31.2
Seeking work, Student, Housework	7.6	11.5	10.4
Retired, Disabled, Other	7.1	9.6	11.4
Education level			
<Primary school	26.5	18.1	14.7
<High school	44.4	46.9	31.3
High school/ Technical & Vocational school	10.2	14.3	10.7
College degree or higher	1.1	2.8	2.9
Mean per capita household income (in 1000 RMBs) <sup>2</sup>	1.5	3.7	9.8
Urban/Rural			
Urban	23.1	24.3	20.8
Rural	56.1	50.0	42.3

1. Percentages in categories may not sum to 100% due to missing values

2. Mean

Table 2. Differences in Drinking Patterns between Years for Men and Women

Comparison Years	Current Drinkers <sup>1</sup> (%)			Mean Weekly Consumption <sup>2</sup> (Standard Drinks)			% Frequent Drinkers <sup>3</sup> (%)			% Heavy Drinkers <sup>3</sup>		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
1993	30.9**	53.0***	10.3	8.6***	9.7***	2.8**	70.1*	75.8	42.6**	17.9***	19.9***	7.3***
2000	32.9	57.6	9.6	11.4†††	12.5†††	5.3	72.5†††	76.3†††	51.4††	26.3†††	27.7†††	18.3
2009	31.9	56.7^^	8.8^	8.5	9.2	3.8^	63.7^^	67.5^^	40.6	18.7	19.2	15.7^^

1. % among total valid respondents, results from Pearson Chi-Square tests

2. Mean for current drinkers, results from ANOVA

3. % among current drinkers, results from Pearson Chi-Square tests

Note: Asterisks indicate \*\*\* $P < 0.001$ , \*\* $P < 0.01$ , \* $P < 0.05$  between 1993 and 2000, †  $P < 0.001$ , ††  $P < 0.01$ , †††  $P < 0.05$  between 2000 and 2009, ^  $P < 0.001$ , ^^  $P < 0.01$ , ^^†  $P < 0.05$  between 1993 and 2009

Table 3. Multilevel logistic regression analysis of the association between socio-demographic variables and current drinking

	1993			2000			2009		
	Total OR (95%CI)	Male OR (95%CI)	Female OR (95%CI)	Total OR (95%CI)	Male OR (95%CI)	Female OR (95%CI)	Total OR (95%CI)	Male OR (95%CI)	Female OR (95%CI)
Gender									
Male <sup>1</sup>	1.00	--	--	1.00	--	--	1.00	--	--
Female	<b>0.02***</b> <b>(0.02-0.03)</b>	--	--	<b>0.02***</b> <b>(0.02-0.02)</b>	--	--	<b>0.02***</b> <b>(0.02-0.03)</b>	--	--
Age, year									
18-25 y <sup>1</sup>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
26-35 y	<b>1.53*</b> <b>(1.08-2.18)</b>	<b>1.76**</b> <b>(1.16-2.67)</b>	1.15 (0.63-2.10)	<b>2.01***</b> <b>(1.42-2.84)</b>	<b>2.28***</b> <b>(1.53-3.42)</b>	1.27 (0.68-2.37)	1.40 (0.93-2.08)	1.29 (0.80-2.10)	1.63 (0.80-3.32)
36-45 y	<b>2.11***</b> <b>(1.47-3.02)</b>	<b>2.40***</b> <b>(1.54-3.72)</b>	1.52 (0.83-2.80)	<b>2.65***</b> <b>(1.86-3.78)</b>	<b>3.38***</b> <b>(2.22-5.13)</b>	1.37 (0.74-2.54)	<b>1.67*</b> <b>(1.11-2.50)</b>	1.61 (0.99-2.64)	2.03 (1.00-4.12)
46-55 y	<b>1.99***</b> <b>(1.36-2.91)</b>	<b>2.12**</b> <b>(1.34-3.38)</b>	1.60 (0.84-3.04)	<b>2.54***</b> <b>(1.77-3.63)</b>	<b>2.94***</b> <b>(1.93-4.49)</b>	1.40 (0.74-2.66)	<b>1.72**</b> <b>(1.15-2.57)</b>	<b>1.77*</b> <b>(1.08-2.89)</b>	1.76 (0.86-3.58)
56+ y	1.33 (0.88-2.00)	1.41 (0.87-2.31)	1.17 (0.58-2.36)	1.47 (1.00-2.18)	1.32 (0.84-2.08)	1.37 (0.69-2.73)	1.03 (0.68-1.57)	0.88 (0.53-1.45)	1.50 (0.71-3.15)
Marital status									
Never married <sup>1</sup>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Married	<b>1.91***</b> <b>(1.35-2.69)</b>	<b>2.17***</b> <b>(1.45-3.25)</b>	1.12 (0.60-2.08)	<b>1.67**</b> <b>(1.23-2.25)</b>	<b>1.70**</b> <b>(1.21-2.40)</b>	1.13 (0.65-1.97)	<b>1.53*</b> <b>(1.06-2.22)</b>	<b>1.94***</b> <b>(1.27-2.97)</b>	0.68 (0.33-1.40)
Divorced/Separated/ Widowed	<b>2.70***</b> <b>(1.66-4.41)</b>	<b>2.02*</b> <b>(1.04-3.91)</b>	1.83 (0.85-3.93)	<b>1.75*</b> <b>(1.12-2.72)</b>	1.69 (0.95-3.02)	0.93 (0.46-1.89)	1.23 (0.78-1.94)	1.05 (0.61-1.80)	0.76 (0.33-1.71)
Employment status									
Working <sup>1</sup>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Seeking work, Student, Housework	0.79 (0.57-1.08)	0.64 (0.35-1.15)	0.79 (0.54-1.15)	<b>0.73*</b> <b>(0.55-0.98)</b>	<b>0.43**</b> <b>(0.26-0.71)</b>	0.92 (0.64-1.32)	<b>0.62***</b> <b>(0.49-0.80)</b>	<b>0.58**</b> <b>(0.42-0.80)</b>	0.82 (0.60-1.12)
Retired, Disabled, Other	<b>0.63**</b> <b>(0.48-0.83)</b>	<b>0.64**</b> <b>(0.46-0.89)</b>	0.73 (0.45-1.20)	<b>0.63***</b> <b>(0.51-0.79)</b>	0.78 (0.58-1.06)	<b>0.48**</b> <b>(0.30-0.78)</b>	<b>0.44***</b> <b>(0.36-0.54)</b>	<b>0.40***</b> <b>(0.32-0.51)</b>	0.68 (0.46-1.00)
Education level									
<Primary school <sup>1</sup>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
<High school	1.10 (0.90-1.35)	<b>1.40*</b> <b>(1.07-1.83)</b>	0.78 (0.57-1.08)	0.84 (0.68-1.05)	1.15 (0.86-1.55)	<b>0.55**</b> <b>(0.39-0.78)</b>	1.03 (0.84-1.27)	1.13 (0.87-1.47)	0.81 (0.58-1.14)
High school/ Tech. & Voc. school	<b>1.38*</b> <b>(1.05-1.82)</b>	<b>1.95***</b> <b>(1.37-2.77)</b>	0.70 (0.44-1.12)	0.98 (0.74-1.30)	1.28 (0.90-1.83)	0.72 (0.46-1.14)	<b>1.37*</b> <b>(1.06-1.77)</b>	1.17 (0.85-1.61)	<b>1.94**</b> <b>(1.28-2.93)</b>
College Degree and up	1.10 (0.62-1.96)	1.28 (0.67-2.45)	1.23 (0.40-3.81)	0.93 (0.61-1.43)	1.12 (0.67-1.85)	1.06 (0.52-2.16)	<b>1.52*</b> <b>(1.06-2.18)</b>	1.28 (0.83-1.98)	<b>2.55**</b> <b>(1.40-4.67)</b>



	1993			2000			2009		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Mean per capita log HH income (in 1000 RMBs)	<b>1.16**</b> <b>(1.05-1.27)</b>	<b>1.16*</b> <b>(1.03-1.31)</b>	1.17 (1.00-1.36)	<b>1.10*</b> <b>(1.01-1.20)</b>	<b>1.12*</b> <b>(1.02-1.24)</b>	1.09 (0.94-1.25)	<b>1.15***</b> <b>(1.06-1.23)</b>	<b>1.18***</b> <b>(1.08-1.29)</b>	1.05 (0.93-1.19)
Urban/Rural									
Urban <sup>1</sup>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Rural	<b>0.57***</b> <b>(0.44-0.74)</b>	0.78 (0.59-1.03)	<b>0.39***</b> <b>(0.27-0.58)</b>	<b>0.58***</b> <b>(0.45-0.75)</b>	0.77 (0.59-1.01)	<b>0.40***</b> <b>(0.27-0.58)</b>	<b>0.62***</b> <b>(0.49-0.79)</b>	<b>0.74*</b> <b>(0.57-0.95)</b>	<b>0.55**</b> <b>(0.37-0.80)</b>

Note: Asterisks indicate \*\*\* $P < 0.001$ , \*\* $P < 0.01$ , \* $P < 0.05$ ; 1. Reference group

Table 4. Multilevel linear regression analysis of the association between socio-demographic variables and amount of alcohol consumed weekly

	1993			2000			2009		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)
Gender									
Male <sup>1</sup>	--	--	--	--	--	--	--	--	--
Female	<b>-6.41***</b> (0.68)	--	--	<b>-7.75***</b> (0.69)	--	--	<b>-5.53***</b> (0.68)	--	--
Age, year									
18-25 y <sup>1</sup>	--	--	--	--	--	--	--	--	--
26-35 y	<b>2.18*</b> (1.09)	<b>2.85*</b> (1.25)	-0.08 (1.50)	<b>3.60**</b> (1.07)	<b>4.08**</b> (1.20)	1.05 (1.72)	1.49 (1.36)	1.62 (1.52)	1.11 (2.30)
36-45 y	<b>3.92***</b> (1.12)	<b>4.52***</b> (1.29)	1.29 (1.51)	<b>5.77***</b> (1.08)	<b>6.61***</b> (1.21)	1.54 (1.68)	2.63 (1.37)	2.88 (1.53)	2.39 (2.33)
46-55 y	<b>3.10**</b> (1.16)	<b>3.49**</b> (1.34)	1.78 (1.58)	<b>6.63***</b> (1.09)	<b>7.46***</b> (1.22)	1.47 (1.73)	<b>4.90***</b> (1.38)	<b>5.52***</b> (1.53)	2.26 (2.33)
56+ y	<b>3.08*</b> (1.25)	<b>3.35*</b> (1.45)	1.23 (1.69)	<b>6.26***</b> (1.19)	<b>6.98***</b> (1.34)	2.13 (1.82)	<b>5.61***</b> (1.42)	<b>6.06***</b> (1.58)	2.71 (2.41)
Marital status									
Never married <sup>1</sup>	--	--	--	--	--	--	--	--	--
Married	1.32 (1.08)	1.57 (1.22)	0.61 (1.54)	0.03 (0.91)	-0.36 (1.01)	2.47 (1.50)	1.46 (1.26)	1.58 (1.66)	-0.64 (2.28)
Divorced/Separated/ Widowed	0.68 (1.56)	0.68 (1.95)	0.41 (1.85)	1.18 (1.39)	1.63 (1.39)	1.03 (1.80)	0.44 (1.58)	0.65 (1.81)	-1.60 (2.51)
Employment status									
Working <sup>1</sup>	--	--	--	--	--	--	--	--	--
Seeking work, Student, Housework	-0.42 (1.22)	0.45 (1.97)	-0.04 (0.91)	-2.19 (1.13)	-2.64 (1.70)	-1.13 (0.93)	-0.41 (0.83)	-0.10 (1.04)	-0.33 (0.87)
Retired, Disabled, Other	<b>1.84*</b> (0.86)	<b>2.11*</b> (0.99)	-0.52 (1.19)	-0.12 (0.77)	-0.26 (0.87)	-0.19 (1.15)	<b>-2.69***</b> (0.67)	<b>-2.95***</b> (0.75)	-1.28 (1.03)
Education level									
<Primary school <sup>1</sup>	--	--	--	--	--	--	--	--	--
<High school	0.68 (0.66)	0.41 (0.79)	0.14 (0.76)	0.09 (0.71)	-0.09 (0.85)	-1.10 (0.89)	1.16 (0.72)	1.10 (0.84)	0.34 (0.93)
High school/Tech.& Voc. school	0.38 (0.84)	-0.06 (0.98)	0.35 (1.19)	-0.88 (0.85)	-1.11 (1.00)	-2.24 (1.16)	0.54 (0.84)	0.25 (0.98)	0.15 (1.11)
College degree or higher	-2.04 (1.61)	-2.32 (1.83)	-1.22 (2.46)	-1.30 (1.22)	-1.30 (1.40)	<b>-3.32*</b> (1.68)	1.53 (1.13)	1.68 (1.31)	-1.80 (1.51)
Mean household income (in 1000 RMBs)	0.52 (0.29)	-0.75* (0.34)	-0.09 (0.34)	-0.11 (0.26)	-0.17 (0.29)	0.24 (0.41)	0.41 (0.23)	0.48 (0.26)	0.27 (0.31)

	1993			2000			2009		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)
Urban/Rural									
Urban <sup>1</sup>	--	--	--	--	--	--	--	--	--
Rural	<b>3.17***</b> <b>(0.71)</b>	<b>3.51***</b> <b>(0.80)</b>	<b>1.41*</b> <b>(0.71)</b>	1.33 (0.68)	1.23 (0.76)	0.52 (0.70)	<b>1.36*</b> <b>(0.67)</b>	<b>1.55*</b> <b>(0.74)</b>	-0.09 (0.74)

Note: Asterisks indicate \*\*\* $P < 0.001$ , \*\* $P < 0.01$ , \* $P < 0.05$ ; 1. Reference group

Table 5. Multilevel logistic regression analysis of the association between socio-demographic variables and frequent drinking

	1993			2000			2009		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Gender									
Male <sup>1</sup>	1.00	--	--	1.00	--	--	1.00	--	--
Female	<b>0.12***</b> <b>(0.09-0.17)</b>	--	--	<b>0.14***</b> <b>(0.10-0.19)</b>	--	--	<b>0.17***</b> <b>(0.13-0.23)</b>	--	--
Age, year									
18-25 y <sup>1</sup>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
26-35 y	<b>1.65*</b> <b>(1.02-2.68)</b>	<b>1.79*</b> <b>(1.05-3.07)</b>	0.75 (0.22-2.57)	1.57 (0.97-2.52)	<b>1.75*</b> <b>(1.05-2.93)</b>	0.91 (0.20-4.23)	1.71 (0.96-3.03)	1.67 (0.92-3.08)	2.40 (0.27-21.60)
36-45 y	<b>2.31**</b> <b>(1.39-3.83)</b>	<b>2.42**</b> <b>(1.37-4.28)</b>	1.39 (0.41-4.69)	<b>3.25***</b> <b>(1.99-5.30)</b>	<b>3.10***</b> <b>(1.82-5.27)</b>	<b>5.63*</b> <b>(1.23-25.78)</b>	<b>2.47**</b> <b>(1.38-4.43)</b>	<b>2.77**</b> <b>(1.49-5.15)</b>	1.38 (0.15-12.39)
46-55 y	<b>2.22**</b> <b>(1.31-3.78)</b>	<b>2.00*</b> <b>(1.11-3.63)</b>	2.21 (0.61-8.04)	<b>2.66***</b> <b>(1.62-4.36)</b>	<b>2.36**</b> <b>(1.39-4.03)</b>	<b>6.03*</b> <b>(1.27-28.60)</b>	<b>3.74***</b> <b>(2.08-6.73)</b>	<b>3.96***</b> <b>(2.12-7.40)</b>	3.34 (0.38-29.68)
56+ y	<b>2.95***</b> <b>(1.64-5.29)</b>	<b>2.78**</b> <b>(1.43-5.37)</b>	1.93 (0.49-7.58)	<b>3.76***</b> <b>(2.14-6.61)</b>	<b>3.31***</b> <b>(1.79-6.11)</b>	<b>9.89**</b> <b>(1.91-51.28)</b>	<b>3.67***</b> <b>(2.00-6.73)</b>	<b>3.46***</b> <b>(1.82-6.58)</b>	6.80 (0.72-64.11)
Marital status									
Never married <sup>1</sup>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Married	<b>2.47***</b> <b>(1.54-3.98)</b>	<b>2.45**</b> <b>(1.46-4.12)</b>	2.95 (0.78-11.11)	1.45 (0.96-2.20)	1.46 (0.93-2.29)	2.08 (0.53-8.18)	<b>2.17**</b> <b>(1.28-3.68)</b>	<b>2.04*</b> <b>(1.17-3.54)</b>	8.02 (0.56-114.80)
Divorced/ Separated/ Widowed	<b>2.78**</b> <b>(1.34-5.77)</b>	1.69 (0.69-4.13)	<b>5.22*</b> <b>(1.07-25.41)</b>	<b>2.11*</b> <b>(1.06-4.22)</b>	1.52 (0.685-3.40)	4.17 (0.81-21.47)	<b>2.30*</b> <b>(1.17-4.50)</b>	2.01 (0.96-4.22)	5.80 (0.36-94.71)
Employment status									
Working <sup>1</sup>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Seeking work, Student, Housework	1.28 (0.75-2.19)	0.73 (0.32-1.68)	1.75 (0.81-3.77)	0.88 (0.53-1.44)	0.80 (0.39-1.67)	0.64 (0.29-1.44)	1.13 (0.79-1.61)	1.03 (0.67-1.59)	1.44 (0.71-2.92)
Retired, Disabled, Other	0.97 (0.63-1.49)	1.05 (0.64-1.72)	0.83 (0.33-2.12)	0.93 (0.63-1.36)	0.94 (0.62-1.44)	0.84 (0.31-2.27)	0.90 (0.67-1.22)	0.80 (0.58-1.11)	1.69 (0.74-3.88)
Education level									
<Primary school <sup>1</sup>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
<High school	1.21 (0.88-1.66)	1.18 (0.81-1.74)	1.26 (0.69-2.32)	<b>0.69*</b> <b>(0.48-0.99)</b>	0.80 (0.52-1.23)	0.99 (0.48-2.07)	<b>0.63**</b> <b>(0.45-0.87)</b>	<b>0.65*</b> <b>(0.45-0.95)</b>	0.71 (0.34-1.49)
High school/ Tech.& Voc. school	1.00 (0.67-1.49)	0.97 (0.61-1.55)	1.06 (0.40-2.78)	<b>0.67*</b> <b>(0.43-1.02)</b>	0.81 (0.49-1.32)	0.51 (0.19-1.36)	<b>0.50***</b> <b>(0.34-0.73)</b>	<b>0.50**</b> <b>(0.33-0.78)</b>	0.58 (0.24-1.43)
College degree or higher	<b>0.42*</b> <b>(0.20-0.88)</b>	<b>0.43*</b> <b>(0.19-0.95)</b>	0.00 (0.00-0.00)	0.56 (0.31-1.02)	0.62 (0.32-1.21)	0.73 (0.17-3.22)	<b>0.42**</b> <b>(0.25-0.69)</b>	<b>0.49*</b> <b>(0.28-0.86)</b>	<b>0.17*</b> <b>(0.04-0.68)</b>
Mean per capita log HH income (in 1000 RMBs) <sup>2</sup>	<b>1.25**</b> <b>(1.09-1.43)</b>	<b>1.34***</b> <b>(1.14-1.56)</b>	1.03 (0.78-1.36)	1.09 (0.966-1.23)	1.11 (0.97-1.27)	0.98 (0.70-1.37)	<b>1.15**</b> <b>(1.04-1.28)</b>	<b>1.13**</b> <b>(1.01-1.26)</b>	<b>1.36*</b> <b>(1.03-1.80)</b>

	1993			2000			2009		
	Total OR (95%CI)	Male OR (95%CI)	Female OR (95%CI)	Total OR (95%CI)	Male OR (95%CI)	Female OR (95%CI)	Total OR (95%CI)	Male OR (95%CI)	Female OR (95%CI)
Urban/Rural									
Urban <sup>1</sup>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Rural	1.36 (0.97-1.90)	1.39 (0.96-2.03)	1.53 (0.80-2.92)	1.13 (0.82-1.56)	1.03 (0.72-1.47)	<b>1.91*</b> <b>(1.01-3.64)</b>	0.98 (0.73-1.33)	0.95 (0.69-1.32)	1.40 (0.73-2.70)

Note: Asterisks indicate \*\*\* $P < 0.001$ , \*\* $P < 0.01$ , \* $P < 0.05$ ; 1. Reference group

Table 6. Multilevel logistic regression analysis of the association between socio-demographic variables and heavy drinking

	1993		2000			2009		
	Total OR (95%CI)	Male OR (95%CI)	Total OR (95%CI)	Male OR (95%CI)	Female OR (95%CI)	Total OR (95%CI)	Male OR (95%CI)	Female OR (95%CI)
Gender								
Male <sup>1</sup>	1.00	--	1.00	--	--	1.00	--	--
Female	<b>0.27***</b> <b>(0.17-0.43)</b>	--	<b>0.43***</b> <b>(0.31-0.60)</b>	--	--	<b>0.69*</b> <b>(0.49-0.95)</b>	--	--
Age, year								
18-25 y <sup>1</sup>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
26-35 y	<b>2.98**</b> <b>(1.48-6.00)</b>	<b>2.88**</b> <b>(1.41-5.87)</b>	<b>3.45***</b> <b>(1.92-6.20)</b>	<b>3.61***</b> <b>(1.96-6.62)</b>	5.02 (0.19-135.49)	1.92 (0.86-4.27)	1.82 (0.78-4.28)	3.21 (0.34-30.23)
36-45 y	<b>3.28**</b> <b>(1.62-6.66)</b>	<b>3.00**</b> <b>(1.46-6.17)</b>	<b>5.32***</b> <b>(2.96-9.55)</b>	<b>5.59***</b> <b>(3.04-10.28)</b>	7.54 (0.28-204.02)	2.04 (0.91-4.54)	2.06 (0.88-4.83)	2.67 (0.26-27.24)
46-55 y	<b>3.83***</b> <b>(1.86-7.86)</b>	<b>3.32**</b> <b>(1.59-6.93)</b>	<b>5.54***</b> <b>(3.08-9.97)</b>	<b>5.92***</b> <b>(3.21-10.91)</b>	5.41 (0.22-134.78)	<b>3.99**</b> <b>(1.79-8.85)</b>	<b>4.14**</b> <b>(1.77-9.67)</b>	3.78 (0.37-38.44)
56+ y	<b>3.08**</b> <b>(1.44-6.58)</b>	<b>2.77*</b> <b>(1.27-6.03)</b>	<b>5.70***</b> <b>(3.07-10.59)</b>	<b>6.12***</b> <b>(3.20-11.69)</b>	8.64 (0.27-274.77)	<b>4.10**</b> <b>(1.82-9.25)</b>	<b>4.02**</b> <b>(1.69-9.54)</b>	5.03 (0.46-54.57)
Marital status								
Never married <sup>1</sup>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Married	<b>2.17*</b> <b>(1.06-4.46)</b>	<b>2.29*</b> <b>(1.10-4.74)</b>	0.83 (0.55-1.26)	0.75 (0.49-1.16)	3.99 (0.31-50.61)	1.53 (0.75-3.13)	1.76 (0.82-3.81)	0.49 (0.07-3.48)
Divorced/ Separated/ Widowed	1.26 (0.48-3.28)	1.43 (0.52-3.97)	1.14 (0.63-2.08)	1.20 (0.62-2.32)	2.49 (0.16-38.71)	1.14 (0.48-2.69)	1.34 (0.52-3.45)	0.39 (0.04-3.47)
Employment status								
Working <sup>1</sup>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Seeking work, Student, Housework	1.44 (0.69-2.98)	1.59 (0.54-4.63)	0.91 (0.54-1.54)	0.94 (0.45-1.98)	0.96 (0.29-3.14)	1.07 (0.73-1.58)	1.14 (0.72-1.79)	0.91 (0.43-1.91)
Retired, Disabled, Other	1.29 (0.85-1.95)	1.30 (0.84-2.00)	0.96 (0.69-1.33)	0.91 (0.64-1.28)	0.84 (0.31-2.27)	<b>0.58**</b> <b>(0.42-0.80)</b>	<b>0.58**</b> <b>(0.41-0.82)</b>	0.57 (0.21-1.55)
Education level								
<Primary school <sup>1</sup>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
<High school	0.94 (0.68-1.29)	0.94 (0.67-1.33)	0.89 (0.66-1.20)	0.93 (0.67-1.30)	0.60 (0.20-1.84)	1.13 (0.81-1.57)	1.12 (0.78-1.60)	1.24 (0.55-2.79)
High school/ Tech.& Voc. school	1.04 (0.68-1.59)	1.02 (0.66-1.59)	<b>0.64*</b> <b>(0.44-0.93)</b>	0.68 (0.45-1.01)	0.31 (0.06-1.66)	0.82 (0.55-1.21)	0.81 (0.52-1.24)	0.85 (0.31-2.35)
College degree or higher	0.54 (0.19-1.59)	0.54 (0.19-1.60)	0.85 (0.49-1.48)	0.92 (0.51-1.64)	0.20 (0.01-3.04)	1.00 (0.58-1.72)	1.11 (0.62-1.97)	0.34 (0.07-1.66)
Mean per capita log HH income (in 1000 RMBs) <sup>2</sup>	1.13 (0.97-1.31)	1.15 (0.99-1.35)	1.00 (0.89-1.12)	1.00 (0.89-1.12)	1.01 (0.62-1.67)	<b>1.18**</b> <b>(1.05-1.32)</b>	<b>1.16*</b> <b>(1.03-1.32)</b>	1.34 (0.98-1.84)

	1993		2000			2009		
	Total OR (95%CI)	Male OR (95%CI)	Total OR (95%CI)	Male OR (95%CI)	Female OR (95%CI)	Total OR (95%CI)	Male OR (95%CI)	Female OR (95%CI)
Urban/Rural								
Urban <sup>1</sup>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Rural	<b>2.84***</b> <b>(1.99-4.04)</b>	<b>2.69***</b> <b>(1.87-3.86)</b>	1.13 (0.84-1.51)	1.11 (0.82-1.50)	0.88 (0.32-2.42)	1.26 (0.93-1.70)	1.25 (0.91-1.71)	1.23 (0.61-2.49)

Note: Asterisks indicate \*\*\* $P < 0.001$ , \*\* $P < 0.01$ , \* $P < 0.05$ ; 1. Reference group

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**Paper 2:**  
**Alcohol Availability and Consumption in China:**  
**Implications for Alcohol Control Policy**

## Abstract

**Purpose:** Alcohol consumption in China has dramatically risen in the past three decades, as the economic reforms of the 1980s have contributed to increased economic prosperity. Though there continue to be huge disparities in income levels, Chinese economic development has contributed to rising income levels generally, which in turn has increased general access to alcoholic beverages and decreased the price of alcohol relative to disposable income. The growth in access to alcoholic beverages and decreases in price of alcohol relative to disposable income has occurred alongside increases in alcohol consumption and alcohol-related problems, such as increased prevalence of alcohol abuse and dependence and drunk-driving. Policies focusing on the reduction of the availability of alcohol have proven successful in decreasing alcohol consumption and alcohol-related problems in Western countries. This study explores the applicability of these policy approaches in the Chinese context by examining the association of alcohol consumption and two dimensions of alcohol availability, environmental availability (physical access) and cost.

**Methods:** Using panel data from the China Health and Nutrition Survey, we used four-level logistic and linear random-intercept multilevel models to examine the relationship between availability (physical access and cost) and four measures of alcohol consumption from 2004 to 2009: current drinking, quantity of alcoholic beverages consumed per week, frequency of drinking, and heavy drinking.

**Results:** Individuals had significantly lower odds of being a frequent drinker if the alcohol store was located in another neighborhood (OR=0.79, 95% CI: 0.65-0.96) and significantly less odds of being a heavy drinker if there was no alcohol store available (OR=0.13, 95% CI: 0.03-0.56), compared to if the alcohol store was located within the neighborhood. Additionally, individuals drank significantly less if the alcohol store was located in another city ( $b=-1.16$ ,  $SE=0.50$ ) or if no alcohol store was available ( $b=-5.67$ ,  $SE=2.08$ ), compared to if the alcohol store was located within the neighborhood. Higher cost of local beer was significantly associated with lower odds of being a frequent drinker (OR=0.94, 95% CI: 0.89-0.99), significantly less weekly consumption of alcohol ( $b=-0.35$ ,  $SE=0.10$ ), and lower odds of being a heavy drinker (OR=0.92, 95% CI: 0.87-0.97). Higher cost of aged liquor was also significantly associated with lower weekly alcohol consumption ( $b=-0.02$ ,  $SE=0.01$ ) and lower odds of being a heavy drinker (0.995, 95% CI: 0.99-1.00).

**Implications:** Policies concerning zoning of alcohol vendors, such as zoning alcohol vendors outside of residential neighborhoods, may be effective in reducing alcohol consumption and alcohol-related problems. Policies aimed at increasing local beer price and aged liquor, through taxation or minimum pricing schemes, can contribute to lower levels of alcohol consumption, as well as less frequent and heavy drinking, and likely can reduce alcohol-related problems.

## **Introduction**

Alcohol consumption in China has dramatically risen in the past three decades, as the economic reforms of the 1980s have contributed to increased economic prosperity. Though there continue to be huge disparities in income levels, Chinese economic development has contributed to rising income levels generally (Su & Deng, 2014; Zheng, 2013), which in turn has increased general access to alcoholic beverages and decreased the price of alcohol relative to disposable income (Centre for Social and Health Outcomes Research and Evaluation, 2006). Moreover, rising income levels in China have introduced new and growing markets targeted by the global alcohol beverage industry, and consequently, have led to increased production and availability of alcohol (Babor et al, 2010; Casswell & Thamarangsi, 2009; Grant, 1998; Jernigan, 2009).

Alongside increases in alcohol consumption, alcohol-related problems, such as increased prevalence of alcohol abuse and dependence and drunk-driving, have also grown (Cochrane, Chen, Conigrave, & Hao, 2003; Hao, Derson, Shuiyuan, Lingjiang, & Yalin, 1999; Hao et al., 2004; Hao, Chen, & Su, 2005). However, in part due to the fairly short period of time during which these dramatic shifts in Chinese drinking behavior occurred, comprehensive alcohol policy and public health infrastructure to address these problems associated have not yet been established. In other countries with developed alcohol control strategies, policy approaches that reduce availability of alcohol among the general public, such as limiting physical access to alcohol vendors or increasing the cost of alcohol through taxation or minimum pricing schemes, have been demonstrated to be particularly effective in reducing alcohol-related problems (Aguirre-Molina & Gorman, 1996; Anderson, Chisholm, & Fuhr, 2009; Babor et al., 2010; Elder et al., 2010; Grunewald, Ponicki, & Holder, 1993; Österberg, 1992; Rehm & Greenfield, 2008). This study explores the applicability of these policy approaches in the Chinese context by examining the association of alcohol consumption and two dimensions of alcohol availability, environmental availability (physical access) and cost.

### **Alcohol Consumption in China**

According to the World Health Organization (2014), there has been an increase of per capita adult alcohol consumption, measured in litres of pure alcohol, from 1.03 litres in 1970 to 6.7 litres in 2010, a more than six-fold increase. Among current drinkers, per capita alcohol consumption was 15.1 litres of pure alcohol in 2010. Another study, conducted among men and women aged 30-79 from ten urban and rural areas in China, found higher levels of current drinking, with 76% of men and 36% of women reporting drinking in the past 12 months (Millwood et al., 2013). These studies indicate new patterns of alcohol consumption that may be attributable to increasing westernization, urbanization, and liberalization of the economy. In particular, the shift towards a free market economy in the 1980s opened up a vast market for the alcohol beverage industry, and commercial production increased nine-fold from 2.5 kg of beverage alcohol per person to 22.9 kg per person between 1978 and 1997 (Cochrane et al., 2003). The World Health Organization (2014) anticipates that the highest increase of alcohol consumption globally to be in the Western Pacific Region, dominated by the Chinese population, with a per capita consumption increase of 1.5 litres of pure alcohol by 2025.

Concomitant with alcohol consumption increases, alcohol use disorders and alcohol-related problems have also increased (Cochrane et al., 2003; Hao et al., 1999; Hao et al., 2004; Hao et al., 2005). Lee and colleagues (2007) found that alcohol-related problems showed the most increase in all mental health (DSM-IV) disorders in metropolitan China. In a six-center survey study conducted by Hao and colleagues (1999), the prevalence of alcohol dependence



among men was 6.6% and 0.1% in women, for a total of 3.4% overall prevalence. Another study found that the prevalence rate of alcohol abuse was nearly 15% among urban Chinese adults (ages 15-65) (Zhang, Wang, Lu, Qiu, & Fang, 2004). In addition to individual-level harms associated with increased alcohol consumption, social-level harms also present a rising concern; the World Health Organization (2014) estimates that the 2012 death rate of alcohol-attributable traffic accidents was 30.5 per 100,000 men and 22.2 per 100,000 women in China.

### **Alcohol Control Policies: Background and Evidence**

Most policies that seek to prevent and reduce alcohol-related problems come from a public health population-focused prevention framework and fall into two categories, reduction of demand or reduction of availability of alcohol (Babor et al., 2010; Rush, Gliksman, & Brook, 1986). Types of alcohol control policies that fall within the first category of demand reduction include restrictions on advertising and provision of alcohol-related education, while those that are encompassed in the second category of availability reduction primarily involve restrictions on retail and environmental availability, such as increasing the cost of alcohol or limiting physical access to alcohol through constraints on the location, number, or density of alcohol vendors and bars. The strategies in this second category of availability reduction will be the primary focus of this paper.

Policies based on limiting alcohol availability are arguably associated with Ledermann's "distribution of alcohol consumption model", which posits that "increased availability of alcohol produces an increase in the aggregate level of alcohol consumption which, in turn, results in an increase in the level of alcohol-related damage...the model could be stated as: Availability → Consumption → Damage" (Ledermann, 1956 as cited in Rush et al, 1986; Rush et al., 1986, p. 1). Though Ledermann's exact mathematical model has been contested and faced considerable criticism, mainly because this theory postulates that "the distribution of the population along the scale of consumption can be described *mathematically* by a special variant of the log-normal distribution function," and that this model implies an exact relation between the average and variance and the prediction of rigid distribution laws. The core of the critiques, besides some methodological challenges, is that the model should focus on (a) a wider range of alcohol related medical and social problems (main focus of alcohol attributed problem was liver cirrhosis), and (b) structural and behavioral determinants of these problems. However, several scholars have argued that a theory of the distribution of alcohol consumption based on hypotheses about the aggregate-level factors that influence individual drinking behavior are valid in a practical sense, if not mathematically (Skog, 1985). In other words, the basic propositions derived from Ledermann's relevant to prevention issues still hold: "(1) A change in average consumption of alcohol in a population is likely to be accompanied by a change in the same direction in the proportion of heavy consumers; (2) Since heavy use of alcohol generally increases the probability of physical and social damage, the average consumption should be closely related to the prevalence of such damage in any population; (3) Any measures, such as those regulating the availability of alcohol, which may be expected to affect over-all consumption are also likely to affect the prevalence of alcohol problems, and hence should be a central consideration in any program of prevention." (Schmidt & Popham, 1978, p. 402). While application and discussion of Ledermann's model has mostly disappeared in recent scholarship (other than some methodological pieces regarding statistical modeling - see Rehm et al., 2010), much of the recent literature examining the relationship between alcohol availability and price/taxation of alcohol is arguably related to Ledermann's original work.

For example, an established body of more recent research, including several systematic reviews, has found consistently strong evidence that alcohol control policies that reduce availability of alcohol are effective in reducing alcohol consumption and decreasing alcohol-related problems within the United States and Europe (Aguirre-Molina & Gorman, 1996; Anderson et al., 2009; Babor et al., 2010; Elder et al., 2010; Grunewald et al., 1993; Österberg, 1992; Martineau, Tyner, Lorenc, Petticrew, & Lock, 2013; Nelson et al., 2013; Rehm & Greenfield, 2008)

Figure 1 shows the conceptual causal pathway through which alcohol taxation and minimum pricing schemes impact alcohol consumption and alcohol related problems, according to the fundamental economic Law of Demand, in which the quantity of a product is inversely related to its price (Elder et al., 2010). According to this economic principle, “increased price would be expected to lead to a decrease in the quantity of alcoholic beverages demanded, resulting in decreases in excessive alcohol consumption and its harmful consequences” (Elder, 2010, p. 219). The evidence that taxation on alcoholic beverages, minimum pricing, and other policies that make alcohol more expensive have overwhelmingly been found to be especially efficacious and cost-effective strategies to reduce alcohol consumption, alcohol use disorders, and alcohol-related harms, disease, and injury, indicates high support for this model (Anderson et al., 2009; Chaloupka, Grossman & Saffer, 2002; Cook & Durrance, 2013; Cook & Moore, 2002; Elder et al., 2010; Farrell, Manning, & Finch, 2003; Lhachimi et al., 2012; Nelson et al., 2013; Wagenaar, Salois, & Komro, 2009; Wagenaar, Tobler, & Komro, 2010).

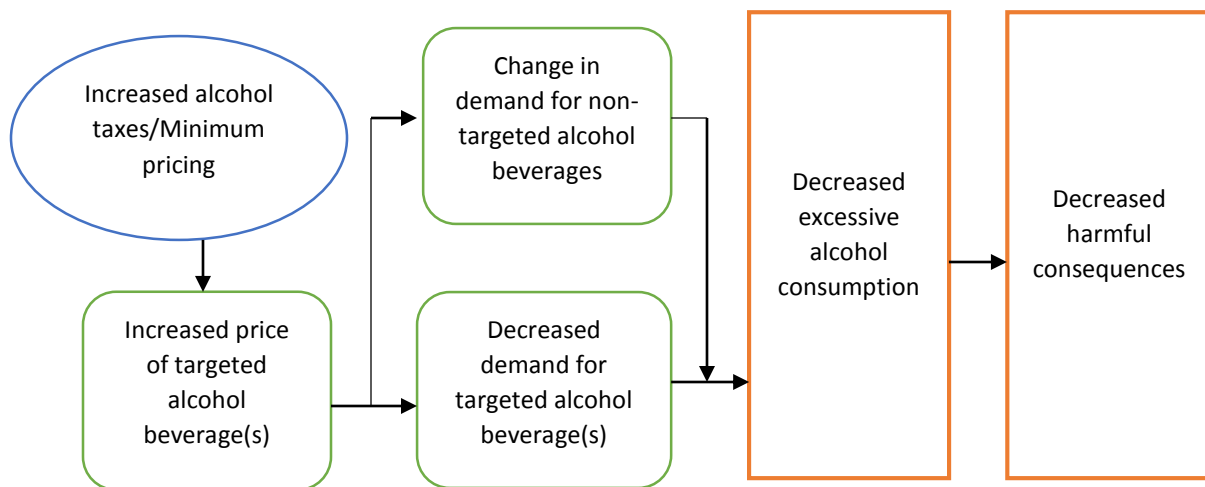


Figure 1. Conceptual model for the causal relationship between increased alcohol taxes and decreased excessive alcohol consumption and related harm (oval indicates intervention; rounded rectangles indicate mediators/intermediate outcomes; rectangle indicate outcomes directly related to improved health) (Elder et al., 2010, p. 219)

Greater alcohol outlet density, number of alcohol vendors, and physical access to alcohol have been associated with increased alcohol consumption and alcohol-related injury, crime, and violence (Bryden, Roberts, Petticrew, & McKee, 2013; Campbell et al., 2009; Grunewald et al., 1993; Halonen et al., 2013; Martineau et al., 2013; Scribner, Cohen, Kaplan, & Allen, 1999;

Treno, Johnson, Remer, & Gruenewald, 2007), while restriction of physical access to alcohol vendors has been found to reduce excessive alcohol consumption and some alcohol-related problems, such as violence and alcohol-related vehicular fatalities (Campbell et al., 2009; Escobedo & Ortiz, 2002; Livingston, Chikrithz, & Room, 2007). This evidence supports the conceptual model proposed by Campbell and colleagues (2009), in which modifying availability physical of alcohol is hypothesized to affect excessive alcohol consumption and related harms by changing access to alcohol through decreasing proximity to alcohol retailers (see Figure 2). Specifically, “decreases in on-premises or off-premises alcohol outlets, or both, are expected to decreases access to alcoholic beverages by increasing the distance to alcohol outlets...thereby decreasing excessive alcohol consumption and related harms” (Campbell et al., 2009, p. 557).

The evidence regarding the effectiveness of these types of alcohol control policies within East Asian countries is much thinner and mixed. While policies restricting physical access to alcohol vendors in East Asian countries are virtually non-existent, either absent or unenforced, most have some level of alcohol taxation (WHO, 2004). However, the few empirical studies that have examined the association of alcohol taxation with alcohol consumption behaviors have mixed findings. Lin, Liao, and Li (2011) found that implementation of alcohol taxation was associated with decreased alcohol attributed disease mortality in Taiwan, while Chung and colleagues (2013) found that decreased taxation was associated with increased alcohol consumption in Hong Kong. However, Chung and colleagues (2013) also found that the prevalence of binge drinking, alcohol abuse, and alcohol dependence decreased following the reduction of alcohol duties, and in the same vein, Desapriya and colleagues (2012) found lower rates of traffic fatalities and higher compliance with alcohol-related driving legislation in Japan following its 1994 alcohol production and sales deregulation policy.

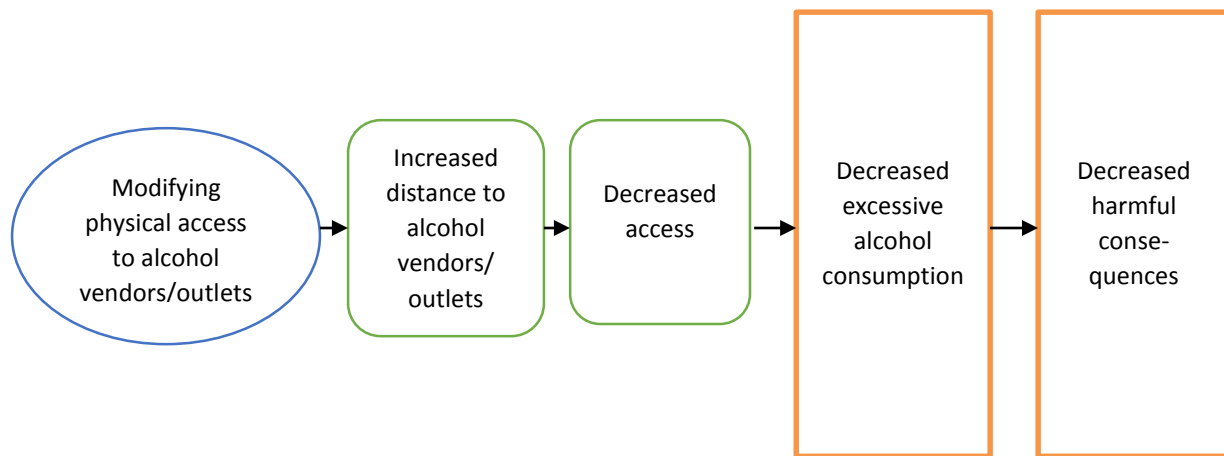


Figure 2. Conceptual model for the causal relationship between modifying physical access to alcohol vendors/outlets and decreased excessive alcohol consumption and related harm (oval indicates intervention; rounded rectangles indicate mediators/intermediate outcomes; rectangle indicate outcomes directly related to improved health) (adapted from Campbell et al., 2009, p. 558)

### Alcohol Control Policies in China

Currently, there are only minimal alcohol control policies in place China, the majority of which are not related to availability reduction (Tang et al., 2013). Although China does impose

minimal alcohol taxation, this is rated as low (<15% of retail price) compared to other countries by the World Health Organization (WHO, 2011b). Additionally, a minimum drinking age law of 18 years that passed in 2006, yet is not enforced and China is still considered not to have a minimum age law for serving and selling alcoholic beverages to minors according to the 2011 WHO alcohol profile for China (WHO, 2004; WHO, 2011b). Perhaps the most successful alcohol-related policy that has been implemented thus far are those imposing stricter penalties on drink- and drunk-driving in 2008 and 2011 (Li, Xie, Nie, & Zhang, 2012; Wan, 2011). Drink- and drunk-driving policies were not stringently enforced until recent years, as increases in incidence of traffic accidents and fatalities, alongside increase in the availability of automobiles, have prompted media and government attention (Hao et al., 2005; Li et al., 2012; Wan, 2011). Nevertheless, policies that provide environmental availability regulation, such as restricting hours and places of sale and density of alcohol outlets, currently do not exist in China (WHO, 2011b).

It is unclear whether these alcohol control policies focusing on availability reduction that have been proven effective in decreasing alcohol consumption and alcohol-related harm in Western countries, and have had mixed impact in other East Asian countries, will be effective within the Chinese context. For example, if cost of alcohol and physical access to alcohol outlets are not found to be associated with increased alcohol use, and the Law of Demand does not hold true for alcohol use in China, these types of alcohol control policies may be less useful there. As noted by Babor and colleagues (2010) note, alcohol is "no ordinary commodity" but rather a psychoactive drug that some may abuse or consume excessively, thus demand for alcohol may be less sensitive to price or difficulties in access in different countries and contexts. Thus, this study seeks to fill this gap in knowledge by seeking to answer to following research questions: (1) Is alcohol consumption (current drinking, amount consumed, frequent drinking, and heavy drinking) associated with physical access (environmental availability) to alcohol in China?; and (2) Is alcohol consumption (current drinking, amount consumed, frequent drinking, and heavy drinking) associated with cost of alcohol in China?

## **Methods**

### **Study Sample**

This research uses publicly available datasets from the China Health and Nutrition Survey (CHNS). The CHNS is an "an ongoing international collaborative project between the Carolina Population Center at the University of North Carolina at Chapel Hill and the National Institute of Nutrition and Food Safety at the Chinese Center for Disease Control and Prevention, ...designed to examine the effects of the health, nutrition, and family planning policies and programs implemented by national and local governments and to see how the social and economic transformation of Chinese society is affecting the health and nutritional status of its population" (CHNS, n.d.). The survey was first administered in 1989, with eight additional panels collected in 1991, 1993, 1997, 2000, 2004, 2006, 2009, and 2011. The most recent survey consists of seven sections which have been developed over time: household survey (including survey items pertaining to household characteristics), health services, individual survey, nutrition and physical examination, community survey, food market survey, and health and family planning facility.

The CHNS study population was drawn from nine Chinese provinces: Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Liaoning, and Shandong (see Figure 3). The study

locations did not include the most interior provinces of China, which are less economically developed than the coastal and near-coastal regions, and consequently, the samples are not nationally representative (Fujita & Hu, 2001). However, the participating provinces do include northern, central, and southern provinces and are socioeconomically and demographically diverse. The CHNS research team stratified counties in the nine participating provinces by income (low, middle, and high), and a multi-stage, cluster weighted sampling process was used to randomly select 4 counties in each province. The provincial capital and a lower income city within each province were selected when possible. Within each county/city, villages, townships, and urban and suburban neighborhoods were then selected randomly. From these sampling units, twenty randomly chosen households were selected and all adults (ages 18 and over) within the households were interviewed. Beginning in 1997, new participants were recruited as replenishment samples “if a community has less than 20 households or if participants have formed a new household or separated from their family into a new housing unit in the same community” (Popkin, Du, Zhai, & Zhang, 2010, p. 1437). Also in 1997, the Liaoning province was not able to participate and the Heilongjiang province was added. In 2000 and in subsequent survey years, both Liaoning and Heilongjiang provinces were surveyed.



Figure 3:  
From: China Health and Nutrition Survey, n.d.

The survey was administered using face-to-face interviews. Typically, the interview team stayed within a community for four or more days and visited each household daily to collect data. Interviews lasted from half an hour to one hour per household for each of the days of data collection. Each household was given a gift of five to twenty dollars as an incentive. Given the complex nature of recruitment, such as replenishment samples, province dropout and return, and individual dropout and return, response rates and attrition for the survey across all study years are difficult to determine (Popkin et al, 2010).

This paper uses data from the 2004, 2006, and 2009 survey waves, which are the only years for which alcohol accessibility and cost survey items were made available; data from the

2011 survey are not yet publicly available. The sample included 15,981 individuals in 2004, 18,045 individuals in 2006, and 18,917 individuals in 2009. From 2004 to 2009, a total of 23,891 individuals were included. Community-level data regarding cost of alcoholic beverages and number of alcohol outlets within each sampling unit were collected from a respondent the research team identified as being knowledgeable about the neighborhood, town, or village, resulting in 216 clusters.

Table 1 contains descriptive data regarding the socio-demographic characteristics of the study population from 2004 to 2009. Gender, educational attainment levels, employment status, and urban/rural categories were approximately equally represented throughout all years included in the present study. The distribution of age categories was skewed towards older age categories for all years. For all years, the majority of respondents reported being married. Additionally, these data show a trend of growing per capita household income from 2004 to 2009.

### **Dependent Variables**

The key dependent variables consist of the four measures of alcohol consumption: (1) current drinking, defined as drinking of any alcoholic beverage in the past year; (2) quantity of alcoholic beverages consumed per week; (3) frequency of drinking; and (4) heavy drinking. The first measure was based on the survey item, “Last year, did you drink beer or any other alcoholic beverage?”

The second measure was derived from survey items about the types of alcohol consumed (beer, wine, and liquor) and the amount of each type consumed per week. Responses were reported in units of number of bottles per week for beer, and number of liangs (50 gm) per week for wine and liquor. These units were converted to approximate standard drink sizes, as defined by the National Institute on Alcohol Abuse and Alcoholism (NIAAA, n.d.), if possible. Units of wine were converted to three liangs (approximately 5 oz.), units of liquor remained as one liang (approximately 1.5 oz.), and units of beer remained as one bottle, given the limitation of this measurement unit and with the assumption that the average size of a bottle of beer is 12 oz. The units for each type of alcoholic beverage were summed to provide number of standard drinks consumed weekly.

The third measure was based on the survey question “How often do you drink beer or any alcoholic beverage,” with the following available response choices: almost every day, 3-4 times a week, once or twice a week, once or twice a month, or no more than once a month. Responses indicating drinking at least once per week or more were coded as frequent drinking, whereas responses indicating drinking twice a month or less were coded as infrequent drinking, based on categories using a modified version of Cahalan, Roizen, and Room's (1976) Quantity-Frequency Index (QF) set forth by NIAAA (2005). Specifically, NIAAA (2005) defined frequent drinking as “drinks at least once a week, and may or may not drink 5 or more drinks at a sitting less than once a week but at least once a year”.<sup>1</sup> In the absence of survey data regarding number of drinks consumed per sitting/drinking occasion, this measure could only be based on the frequency component of this definition.

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<sup>1</sup> Other categories are the following: “Abstainer” defined as “never drinks, or drinks less than once a year”; “Less frequent” defined as “drinks 1 to 3 times a month, and may or may not drink 5 or more drinks, at least once a year”, and “Frequent heavy drinker” defined as “drinks at least once a week, and has 5 or more drinks at one sitting at least once per week”. <http://pubs.niaaa.nih.gov/publications/Social/Module1Epidemiology/Module1.html>

The fourth measure was constructed to compare non-heavy drinkers with heavy drinkers, as defined by NIAAA (n.d.), for which responses indicating more than 7 drinks per week for women and more than 14 drinks per week for men were coded as heavy drinking.

### **Independent Variables**

The key independent variables were analyzed separately to account for collinearity and include variables regarding physical access to alcohol vendors and cost of various alcohol types. The physical access variables include a categorical variable regarding location of stores selling alcoholic beverages (in this village/neighborhood, in this city but a different neighborhood, in another village/town/city, and never buy/no market available), average distance (in kilometers) to stores that sell alcoholic beverages, and the number bars and vendors that sell alcoholic beverages in a sampling unit (neighborhood, village, or town). The alcohol cost variables include average cost of local beer, local liquor, and aged liquor, which are the alcohol types included in the CHNS survey questions. Individual-level socio-demographic variables served as control variables. Additionally, county density (county population/county area in sq. km), which was transformed into its square root to satisfy normality assumptions, served as a community control variable.

### **Analysis**

This study employed separate analyses for each combination of the four dependent alcohol consumption variables and the six independent alcohol availability variables, using the STATA 13 statistical data analysis software package. Four-level logistic random intercept multilevel models were used for the three dichotomous dependent variables, current drinking, frequent drinking, and heavy drinking. For the continuous dependent variable, number of standard drinks consumed weekly, a four-level generalized mixed linear multilevel model was used. For both linear and logistic models, time was nested within the individual, the individual was nested within the household level, which was nested within the community level (see Monda, Gordon-Larsen, Stevens, & Popkin, 2007) for a similar analysis assessing association of urbanization with occupational activity using CHNS data). These models were selected to account for clustering of data and provide more robust confidence intervals and significance tests, as well as address repeated measurement (Rabe-Hesketh & Skrondal, 2005). Degree of freedom tests and ANOVAs were conducted to test the categorical independent variables, which indicated the statistical significance of the categories included in the analyses. Likelihood ratio tests were conducted to test the full four-level model and the restricted one-level model.

## **Results**

### **Environmental Availability (Physical Access)**

Table 2 presents the results of regression analyses examining the association between the four measures of alcohol consumption (current drinking, weekly alcohol consumption, frequent drinking, and heavy drinking) and categorical location of stores selling alcoholic beverages. Individuals had significantly lower odds of being a frequent drinker if the alcohol store was located in another neighborhood compared to if the alcohol store was located within the neighborhood (OR=0.79, 95% CI: 0.65-0.96), with the direction of non-significant findings reflecting decreased likelihood of being a frequent drinker with location of an alcohol store outside the neighborhood. Individuals were significantly less likely to be a heavy drinker if an

alcohol store was not available compared to if the alcohol store was located within the neighborhood (OR=0.13, 95% CI: 0.03-0.56), again with the direction of non-significant findings reflecting decreased likelihood of being a heavy drinker with location of an alcohol store outside the neighborhood. Additionally, individuals drank significantly less if the alcohol store was located in another city ( $b=-1.16$ ,  $SE=0.50$ ) or if no alcohol store was available ( $b=-5.67$ ,  $SE=2.08$ ), compared to if the alcohol store was located within the neighborhood. However, findings indicate significantly higher odds of being a current drinker if an alcohol store was located in another city compared to if an alcohol store was located within the neighborhood (OR=1.20, 95% CI: 1.02-1.42), with direction of non-significant findings reflecting increased likelihood of being a current drinker with location of an alcohol store outside the neighborhood.

Tables 3 and 4 present the results of regression analyses examining the association between the four measures of alcohol consumption (current drinking, weekly alcohol consumption, frequent drinking, and heavy drinking) and the number of bars within the neighborhood and the average distance to stores selling alcohol, respectively. There was no detectable association between number of neighborhood bars with current drinking (OR=1.00, 95% CI: 1.00-1.00), amount of alcohol consumed weekly ( $b=0.02$ ,  $SE=0.01$ ), frequent drinking (OR=1.00, 95% CI: 1.00-1.00), or heavy drinking (OR=1.00, 95% CI: 1.00-1.01). Similarly, there were no statistically significant findings of association between average distance to stores selling alcohol and current drinking (OR=1.00, 95% CI: 0.98-1.02), amount of alcohol consumed weekly ( $b=-0.07$ ,  $SE=0.06$ ), frequent drinking (OR=0.98, 95% CI: 0.95-1.01), or heavy drinking (OR=0.98, 95% CI: 0.95-1.02).

## Cost

Table 5 presents the results of regression analyses examining the association between the four measures of alcohol consumption and the cost of local beer. Findings indicate significantly lower odds of being a frequent drinker the higher the cost of local beer (OR=0.94, 95% CI: 0.89-0.99). Similarly, higher cost of local beer was associated with decreased likelihood of being a heavy drinker (OR=0.92, 95% CI: 0.87-0.97). Furthermore, individuals drank significantly less the higher the cost of local beer ( $b=-0.35$ ,  $SE=0.10$ ). Current drinking was not significantly associated with the cost of local beer (OR=1.02; 95% CI: 0.99-1.06).

Table 6 displays the results of regression analyses examining the association between alcohol consumption and the cost of local liquor. Individuals were significantly more likely to be current drinkers the higher the average cost of local liquor (OR=1.01, 95% CI: 1.00-1.02). Amount of alcohol consumed weekly ( $b=0.00$ ,  $SE=0.02$ ), frequent drinking (OR=1.00, 95% CI: 0.98-1.00), and heavy drinking (OR=1.00, 95% CI: 0.99-1.01) were not found to be significantly associated with the cost of local liquor.

Table 7 shows the results of regression analyses examining the association between alcohol consumption and the cost of aged liquor. Higher cost of aged liquor was significantly negatively associated with amount of alcohol consumed weekly ( $b=-0.02$ ,  $SE=0.01$ ). Higher cost of aged liquor was also associated with significantly decreased odds of being a heavy drinker (OR=0.995, 95% CI: 0.99-1.00) However, the cost of aged liquor was not significantly associated with current drinking (OR=1.00, 95% CI: 1.00-1.00) nor frequent drinking (OR=1.00, 95% CI: 0.99-1.00).



## Covariates

Though covariates were included in the models as individual- and community-level control variables, a summary of significant findings across the majority of the regression analyses is presented here given their implications for practice and policy interventions. Women were found to be significantly less likely to be current, frequent, and heavy drinkers, and consume significantly less alcohol compared to men. Older age groups were significantly more likely to be current, frequent, and heavy drinkers and consume significantly more alcohol compared to the youngest age group. Married persons were significantly more likely to be current and frequent drinkers compared to never married persons. Compared to working individuals, non-working individuals were found to be less likely to be current drinker and consume significantly less alcohol. Though not consistently significant across all analyses, retired, disabled, and otherwise non-working individuals were less likely to be heavy drinkers compared to working individuals. Those with higher levels of educational attainment were more likely to be current drinkers, but less likely to be frequent drinkers, compared to the lowest educational attainment group. Additionally, increased income was associated with increased odds off current drinking. Finally, rural individuals were less likely to be current drinkers, but rural drinkers consumed significantly more alcohol, compared to their urban counterparts.

## Discussion/Conclusion

The findings from this present study regarding the association between availability of alcohol and alcohol consumption in China are mixed. In particular, the findings of the increased likelihood of current drinking with location of alcohol vendors outside the neighborhood (compared to having alcohol vendors located within the neighborhood), as well as higher local liquor costs, are unexpected. These findings may indicate that the decision to currently drink, defined in this study as having had at least one drink in the past twelve months, is more complicated than merely including consideration of environmental availability (physical access) and cost. This is aligned with critiques of Ledermann's model that alcohol consumption is influenced by other factors in addition to population-level alcohol availability, such as social, cultural, behavioral, normative, and individual factors (Parker & Harman, 1978; Skog, 1985).

Given the cultural context of drinking within China, particularly the ritualized practice of work-related alcohol consumption as a means to forge and maintain *guanxi*, or relationships, and bond with superiors and colleagues, it is possible that those who currently drink may do so within the vicinity of their places of employment rather than within their neighborhood (Cochrane et al., 2003; Hao et al., 2005; Zhou, Zhang, Hu, Fan, & Hao, 2013). The finding that employment is significantly associated with higher likelihood of current drinking, increased levels of consumption, and to some extent heavy drinking support this hypothesis. Several news articles have been published in recent years regarding the Chinese culture and practice of employment-related drinking, during which binge drinking and participating in toasts to *gan bei*, translated literally as "dry cup," are seen as essential to building *guanxi* (Hong, 2009; Jie, 2009; Szeto, 2013). One case reported recently described a Chinese employer who based yearly employee bonuses on the amount of alcohol they could consume, and in response to employee complaints, defended this practice by stating that much of the success of the business depended on the ability to "hold liquor" when entertaining clients ("Chinese employer ties year-end bonuses to how much workers could drink", 2014; Hofmann, 2014). As cases like this have increasingly garnered media attention and public criticism, including a number of incidents in

which Chinese Communist Party officials have died as a result of work-related drinking, the Chinese government has responded by initiating calls to end alcohol-infused banquets and celebrations for government officials, and some local governments have banned drinking during working hours (Hong, 2009; Tang et al., 2013; Yap, 2013). However, the government response to work-related drinking in these cases is part of a larger anti-corruption crackdown, rather than representing a direct focus on addressing and reducing problematic alcohol consumption behaviors (Yap, 2013).

Though the present study could not assess the relationship between the specific behavior of binge-drinking and employment, the increased likelihood of current drinking and heavier alcohol consumption among employed persons suggest that policies aimed at addressing employment-related drinking and its associated problems should be adopted. These may prove challenging in the Chinese context, given the deep entrenchment of *guanxi* and the role of the *ganbei* culture in building and maintaining *guanxi* relationships. Nevertheless, as the consequences of these problematic drinking behaviors and practices come to the forefront, the Chinese government has an opportunity to not only remove funding for government-related alcohol activities, but also to engage in public campaigns to shift social norms regarding alcohol consumption and promote awareness of the harms associated with hazardous alcohol consumption, particularly heavy and binge drinking, among the general population. Additionally, the adoption of policies prohibiting work incentives and performance rewards on the basis of alcohol consumption can provide legal recourse for Chinese employees subject to these practices.

Another unique aspect of alcohol consumption in the Chinese context is the sense of community pride in supporting local products with a long-standing history, including high quality and likely higher-costing local liquor, which may explain the findings that higher cost of local liquor is associated with higher odds of current drinking. Similar to the association between particular types of tea and provinces in China, such as the association between Pu-erh tea and the Yunnan province, certain higher-priced brands of liquor are associated with particular locales, such as Maotai liquor and the Guizhou province (Zhu, 2013). Another possibility is that demand for local liquor does not vary with cost in the Chinese context; drinking occasions involving the traditional consumption of local liquor, such as holidays and celebrations, may contribute to stable demand and price inelasticities of these types of alcohol. Moreover, the odds that an individual is likely to be a current drinker given the increased cost of local liquor is extremely close to one, indicating very little magnitude in terms of the impact of local liquor cost on current drinking. Further research, particularly qualitative research, is needed to understand these findings regarding the higher likelihood of current drinking associated with alcohol availability in locations outside of the neighborhood and higher local liquor costs.

Additionally, current drinking is not a strong indicator of problematic alcohol consumption, especially compared to measures of heavy and frequent drinking, and amount of alcohol consumed. Consequently, the findings regarding these latter three measures of alcohol consumption likely have stronger implications for alcohol control policy. Though distance to stores selling alcoholic beverages and the number of bars located within the neighborhood were not associated with frequent drinking or amount of alcohol consumed weekly, absence of alcohol vendors within the neighborhood was found to impact frequent drinking, heavy drinking, and amount of alcohol consumed, providing some evidence to support Campbell's and colleagues' (2009) model regarding the relationship between modifying physical access to alcohol vendors/outlets and decreased excessive alcohol consumption to be applicable to China. These

findings suggests that policies aimed at reducing density of alcohol vendors may not be effective if at least one alcohol vendor is already present within the neighborhood, given that proximity to alcohol vendors in the neighborhood and the number of bars within a neighborhood have no significant effect on alcohol consumption. However, policies concerning zoning of alcohol vendors, such as zoning alcohol vendors outside of residential neighborhoods, may be effective in reducing alcohol consumption and alcohol-related problems (Ashe, Jernigan, Kline, & Galaz., 2003).

Cost of local beer and aged liquor was found to have a significant impact on heavy drinking and amount of alcohol consumed, and cost of local beer was also associated with frequent drinking. In other words, individuals consumed less alcohol and were less likely to be heavy drinkers the higher the cost of local beer and aged liquor, providing support that the Law of Demand and the model proposed by Elder and colleagues (2010) have bearing on Chinese alcohol consumption behaviors. While beer in China is relatively low cost and culturally is not viewed as “real” alcohol, these findings suggest that cost of beer plays a significant factor in how much and how frequently a person drinks alcohol, contrary to findings from Western-based studies that have found beer to be less responsive to price compared to wine and spirits (Cook & Moore, 2002; Wagenaar et al., 2009). Moreover, at least anecdotally, beer consumption is increasing in popularity and beer demand is growing in China (Jun, 2013). On the other hand, aged liquor is the most expensive type of alcohol in China; while these may be of the same brand as local liquor, the greater the age of these types of liquor, such as Maotai, the greater their price and regard as a status symbol, much like wine in Western countries. While the status symbol of this type of liquor should indicate that higher price should have no effect on demand, or perhaps even higher level of demand, the finding that this type of alcohol is negatively sensitive to cost suggests a possible substitution effect; as noted in Elder’s and colleagues’ model, increasing cost of one type of alcoholic beverage decreases the demand for the targeted beverage but changes, and likely increases demand, for other types of alcohol – perhaps lower-costing local liquor.

Nevertheless, these findings regarding beer and aged liquor consumption suggest that policies aimed at increasing local beer and aged alcohol price in China can contribute to lower and less frequent and heavy alcohol consumption, and likely, alcohol use disorders and other alcohol-related problems. Furthermore, studies examining the potential effect of taxation of cigarettes, another so-called “sin” commodity, indicate that taxation strategies can reduce consumption of these types of goods in the Chinese context (Bishop, Liu, & Meng, 2007; Chen & Xing, 2011).

However, models determining the exact tax levels and minimum pricing schemes for alcohol that will be effective in China will have to be developed. As noted in Western-based studies, benefits and costs of increasing the price of alcohol may be distributed unevenly among different types of drinkers and groups with different socio-economic levels (Chalmers, Carragher, Davoren, & O’Brien, 2013; Daley, Stahre, Chaloupka, & Naimi, 2012; Holmes et al., 2014; Purshouse, Meier, Brennan, Taylor, & Rafia, 2010). The present study included per capita household income level, employment status, and education levels as covariates to control for their effects on the association between alcohol availability and consumption; the results indicated that all three of these had independent significant effects on alcohol consumption, exclusive of environmental availability (physical access) and cost of alcohol. Further research is needed to examine the differential impact of availability restriction policies on different socio-economic groups. These and other covariates included as controls in this study provide additional implications for practice and policy interventions; specifically, older individuals,

males, married persons, and those residing in rural locations have higher consumption levels and/or increased likelihood of frequent drinking, and increased screening for alcohol-related problems, as well as other targeted health promotion initiatives, may be useful in addressing alcohol-related problems among these at-risk groups.

Furthermore, in the model proposed by Elder and colleagues (2010), increased cost of targeted alcoholic beverages leads to the decreased demand of those specific beverages, but can also potentially increase the demand for other types of alcoholic beverages. Thus, the findings regarding local and aged liquor cost and their impact on alcohol consumption in this study may provide evidence of this phenomenon of a substitution effect. For example, aged liquor is considered a luxury item, but local non-aged liquor may be less sensitive to price due to its lower cost compared to aged liquor; people may choose to purchase this type of liquor in place of more costly types.

As noted earlier, one study limitation was that the most refined alcohol consumption quantity measure asked only about quantity of alcohol consumed per week, not per drinking episode, which precludes the ability to analyze factors associated with binge drinking, defined as five or more alcoholic beverages consumed by men and four or more alcoholic beverages consumed by women per two-hour drinking episode (NIAAA, 2004). As Rehm (1998) notes, frequency only measures cannot differentiate between light, moderate, and heavy drinkers per drinking occasion nor identify variability in drinking patterns, both of which influence immediate and chronic outcomes. Future research should investigate the direct association of alcohol availability with problematic drinking patterns, such as heavy frequent drinking and binge drinking, and alcohol-related problems.

Another limitation of this study is that alcohol use disorders and other alcohol-related problems were not included in the CHNS, consequently, this study could not examine the direct relationship of these with alcohol environmental availability (physical access) and cost. Additionally, statistical analysis examining patterns of drinking (combined frequency and amount) could not be performed due to very small numbers of people reporting heavy infrequent drinking and current lack of appropriate regression techniques for multi-level analyses of categorical outcomes.

Nevertheless, this study is one of the first to examine the impact of alcohol availability on alcohol consumption behaviors in China, with important implications for next steps in China's alcohol control policy. While evidence supporting policies that increase the cost and decrease physical access to alcohol have been found in previous studies conducted in Western countries, the present study has found similar effects in China, particularly for zoning alcohol retailers outside of residential neighborhoods and implementing price increases on local beer and aged liquor, with the caveat that price increases should account for substitution effects.

Table 1. General Demographic Characteristics

	% of Total N <sup>1</sup>	% of Total N <sup>1</sup>	% of Total N <sup>1</sup>
	2004 (N=16,243)	2006 (N=18,885)	2009 (N=18,917)
Gender			
Male	48.6	46.1	41.8
Female	48.7	48.9	44.0
Age, year			
18-25 y	4.7	3.4	3.8
26-35 y	10.1	7.4	6.3
36-45 y	13.0	11.7	11.7
46-55 y	14.8	12.2	12.1
56+ y	17.8	16.8	19.2
Marital status			
Never married	5.5	3.8	3.6
Married	49.6	43.1	44.2
Divorced/Separated/ Widowed	4.7	4.3	5.2
Employment status			
Working	36.4	30.4	31.2
Seeking work, Student, Housework	12.5	10.6	10.4
Retired, Disabled, Other	11.5	10.5	11.4
Education level			
<Primary school	16.2	15.7	14.7
<High school	39.6	29.0	31.3
High school/ Technical & Vocational school	12.9	11.4	10.7
College degree or higher	2.4	2.9	2.9
Mean per capita household income (in 1000 RMBs) <sup>2</sup>	5.2	6.1	9.9
Urban/Rural			
Urban	25.0	20.7	20.8
Rural	50.0	41.5	42.3

1. Percentages in categories may not sum to 100% due to missing values

2. Mean

Table 2. Access: Multilevel logistic regression analysis of the association between categorical location of alcohol stores and alcohol consumption

	Alcohol Consumption Measures			
	Current drinking OR (95% CI)	Weekly alcohol consumption $\beta$ (SE)	Frequent drinking OR (95% CI)	Heavy drinking OR (95% CI)
<b>Categorical location of alcohol stores</b>				
Alcohol store located in neighborhood <sup>1</sup>	1.00	--	1.00	1.00
Alcohol store located within the city	1.00 (0.89-1.14)	-0.47 (0.42)	<b>0.79*</b> <b>(0.65-0.96)</b>	0.85 (0.70-1.04)
Alcohol store located in another city	<b>1.20*</b> <b>(1.02-1.42)</b>	<b>-1.16*</b> <b>(0.50)</b>	0.88 (0.70-1.13)	0.82 (0.64-1.04)
No alcohol store available	1.49 (0.80-2.76)	<b>-5.67**</b> <b>(2.08)</b>	0.49 (0.19-1.23)	<b>0.13**</b> <b>(0.03-0.56)</b>
<b>Gender</b>				
Male <sup>1</sup>	1.00	--	1.00	1.00
Female	<b>0.01***</b> <b>(0.01-0.02)</b>	<b>-6.75***</b> <b>(0.47)</b>	<b>0.15***</b> <b>(0.12-0.19)</b>	<b>0.51***</b> <b>(0.40-0.65)</b>
<b>Age, year</b>				
18-25 y <sup>1</sup>	1.00	--	1.00	1.00
26-35 y	<b>1.65***</b> <b>(1.26-2.17)</b>	1.46 (0.85)	<b>2.02***</b> <b>(1.41-2.90)</b>	<b>2.02**</b> <b>(1.20-3.41)</b>
36-45 y	<b>1.95***</b> <b>(1.48-2.58)</b>	<b>3.44***</b> <b>(0.86)</b>	<b>3.17***</b> <b>(2.19-4.60)</b>	<b>3.33***</b> <b>(1.98-5.60)</b>
46-55 y	<b>1.87***</b> <b>(1.41-2.47)</b>	<b>5.25***</b> <b>(0.86)</b>	<b>4.29***</b> <b>(2.94-6.27)</b>	<b>4.96***</b> <b>(2.94-0.36)</b>
56+ y	1.23 (0.93-1.68)	<b>5.24***</b> <b>(0.90)</b>	<b>4.20***</b> <b>(2.82-6.24)</b>	<b>4.89***</b> <b>(2.86-8.37)</b>
<b>Marital status</b>				
Never married <sup>1</sup>	1.00	--	1.00	1.00
Married	<b>1.69***</b> <b>(1.41-2.47)</b>	1.45 (0.75)	<b>1.65**</b> <b>(1.20-2.27)</b>	1.43 (0.94-2.17)
Divorced/Separated/Widowed	<b>1.44*</b> <b>(1.04-1.98)</b>	0.74 (1.00)	<b>2.12**</b> <b>(1.35-3.33)</b>	1.36 (0.81-2.29)
<b>Employment status</b>				
Working <sup>1</sup>	1.00	--	1.00	1.00
Seeking work, Student, Housework	<b>0.59***</b> <b>(0.51-0.69)</b>	<b>-1.08*</b> <b>(0.53)</b>	1.07 (0.84-1.35)	0.83 (0.63-1.08)
Retired, Disabled, Other	<b>0.47***</b> <b>(0.40-0.55)</b>	<b>-1.76***</b> <b>(0.46)</b>	1.06 (0.99-1.14)	<b>0.67***</b> <b>(0.54-0.83)</b>
<b>Education level</b>				
<Primary school <sup>1</sup>	1.00	--	1.00	1.00
<High school	0.99 (0.86-1.16)	-0.39 (0.48)	<b>0.76*</b> <b>(0.60-0.96)</b>	0.87 (0.70-1.08)
High school/ Tech.& Voc. school	<b>1.34**</b> <b>(1.10-1.63)</b>	-0.42 (0.57)	<b>0.72*</b> <b>(0.55-0.95)</b>	0.78 (0.60-1.02)
College degree or higher	<b>1.54**</b> <b>(1.16-2.05)</b>	-1.01 (0.81)	<b>0.59**</b> <b>(0.41-0.85)</b>	0.72 (0.49-1.07)
Mean per capita log HH income (in 1000 RMBs) <sup>2</sup>	<b>1.09***</b> <b>(1.04-1.15)</b>	-0.15 (0.15)	1.06 (0.99-1.14)	1.03 (0.96-1.10)
<b>Urban/Rural</b>				
Urban <sup>1</sup>	1.00	--	1.00	1.00
Rural	<b>0.55***</b> <b>(0.44-0.70)</b>	<b>1.59*</b> <b>(0.62)</b>	1.18 (0.89-1.56)	1.20 (0.91-1.57)
Density (Square Root)	1.00 (1.00-1.00)	-0.01* (0.01)	1.00 (1.00-1.00)	1.00 (0.99-1.00)

Note: Asterisks indicate \*\*\* $P < 0.001$ , \*\* $P < 0.01$ , \* $P < 0.05$ ; 1. Reference group

Table 3. Access: Multilevel logistic regression analysis of the association between number of neighborhood bars and alcohol consumption

	Alcohol Consumption Measures			
	Current drinking OR (95% CI)	Weekly alcohol consumption $\beta$ (SE)	Frequent drinking OR (95% CI)	Heavy drinking OR (95% CI)
Number of neighborhood bars	1.00 (1.00-1.00)	0.02 (0.01)	1.00 (1.00-1.00)	1.00 (1.00-1.01)
Gender				
Male <sup>1</sup>	1.00	--	1.00	1.00
Female	<b>0.01***</b> (0.01-0.02)	<b>-6.87***</b> (0.47)	<b>0.15***</b> (0.12-0.19)	<b>0.49***</b> (0.39-0.63)
Age, year				
18-25 y <sup>1</sup>	1.00	--	1.00	1.00
26-35 y	<b>1.62***</b> (1.24-2.13)	1.42 (0.86)	<b>2.09***</b> (1.46-3.01)	<b>1.99*</b> (1.18-3.34)
36-45 y	<b>1.93***</b> (1.46-2.55)	<b>3.46***</b> (0.86)	<b>3.35***</b> (2.31-4.86)	<b>3.19***</b> (1.90-5.36)
46-55 y	<b>1.83***</b> (1.38-2.47)	<b>5.15***</b> (0.87)	<b>4.51***</b> (3.08-6.60)	<b>4.67***</b> (2.78-7.85)
56+ y	1.24 (0.92-1.66)	<b>5.18***</b> (0.91)	<b>4.40***</b> (2.95-6.55)	<b>4.57</b> (2.68-7.79)
Marital status				
Never married <sup>1</sup>	1.00	--	1.00	1.00
Married	<b>1.72***</b> (1.41-2.47)	<b>1.48*</b> (0.75)	<b>1.60**</b> (1.16-2.20)	1.43 (0.94-2.17)
Divorced/Separated/Widowed	<b>1.47*</b> (1.06-2.02)	0.94 (1.00)	<b>1.93**</b> (1.23-3.02)	1.39 (0.83-2.34)
Employment status				
Working <sup>1</sup>	1.00	--	1.00	1.00
Seeking work, Student, Housework	<b>0.60***</b> (0.52-0.70)	-0.99 (0.53)	1.07 (0.84-1.35)	0.84 (0.65-1.09)
Retired, Disabled, Other	<b>0.47***</b> (0.40-0.55)	<b>-1.71***</b> (0.46)	1.03 (0.83-1.28)	<b>0.68**</b> (0.55-0.85)
Education level				
<Primary school <sup>1</sup>	1.00	--	1.00	1.00
<High school	1.00 (0.86-1.16)	-0.43 (0.49)	<b>0.73**</b> (0.58-0.93)	0.86 (0.69-1.07)
High school/ Tech.& Voc. school	<b>1.33**</b> (1.10-1.62)	-0.42 (0.58)	<b>0.70*</b> (0.53-0.92)	.77 (0.59-1.01)
College degree or higher	<b>1.55**</b> (1.17-2.06)	-1.07 (0.81)	<b>0.56**</b> (0.39-0.82)	0.70 (0.47-1.05)
Mean per capita log HH income (in 1000 RMBs) <sup>2</sup>	<b>1.10***</b> (1.04-1.15)	-0.11 (0.15)	1.06 (0.99-1.14)	1.03 (0.96-1.11)
Urban/Rural				
Urban <sup>1</sup>	1.00	--	1.00	1.00
Rural	<b>0.57***</b> (0.45-0.72)	<b>1.45*</b> (0.63)	1.20 (0.90-1.59)	1.18 (0.89-1.55)
Density (Square Root)	1.00 (1.00-1.00)	<b>-0.01*</b> (0.01)	1.00 (1.00-1.00)	1.00 (1.00-1.00)

Note: Asterisks indicate \*\*\* $P < 0.001$ , \*\* $P < 0.01$ , \* $P < 0.05$ ; 1. Reference group

Table 4. Access: Multilevel logistic regression analysis of the association between average distance to stores selling alcohol and alcohol consumption

	Alcohol Consumption Measures			
	Current drinking OR (95% CI)	Weekly alcohol consumption $\beta$ (SE)	Frequent drinking OR (95% CI)	Heavy drinking OR (95% CI)
Average distance to stores selling alcohol	1.00 (0.98-1.02)	-0.07 (0.06)	0.98 (0.95-1.01)	0.98 (0.95-1.02)
Gender				
Male <sup>1</sup>	1.00	--	1.00	1.00
Female	<b>0.01***</b> <b>(0.01-0.02)</b>	<b>-6.69***</b> <b>(0.54)</b>	<b>0.15***</b> <b>(0.11-0.20)</b>	<b>0.47***</b> <b>(0.35-0.63)</b>
Age, year				
18-25 y <sup>1</sup>	1.00	--	1.00	1.00
26-35 y	<b>1.50*</b> <b>(1.07-2.11)</b>	1.47 (1.02)	<b>2.34***</b> <b>(1.47-3.74)</b>	<b>2.33**</b> <b>(1.19-4.56)</b>
36-45 y	<b>1.81**</b> <b>(1.28-2.57)</b>	<b>3.32**</b> <b>(1.04)</b>	<b>3.44***</b> <b>(2.12-5.57)</b>	<b>3.70***</b> <b>(1.89-7.22)</b>
46-55 y	<b>1.70**</b> <b>(1.19-2.42)</b>	<b>4.74***</b> <b>(1.04)</b>	<b>4.49***</b> <b>(2.75-7.35)</b>	<b>5.20***</b> <b>(2.66-10.18)</b>
56+ y	1.30 (0.90-1.88)	<b>4.54***</b> <b>(1.09)</b>	<b>4.49***</b> <b>(2.69-7.50)</b>	<b>5.35***</b> <b>(2.69-10.67)</b>
Marital status				
Never married <sup>1</sup>	1.00	--	1.00	1.00
Married	<b>1.63**</b> <b>(1.19-2.21)</b>	1.23 (0.89)	<b>1.57*</b> <b>(1.04-2.37)</b>	1.32 (0.79-2.21)
Divorced/Separated/Widowed	1.45 (0.97-2.16)	0.84 (1.18)	<b>2.15**</b> <b>(1.21-3.82)</b>	1.36 (0.73-2.55)
Employment status				
Working <sup>1</sup>	1.00	--	1.00	1.00
Seeking work, Student, Housework	<b>0.56***</b> <b>(0.46-0.68)</b>	-0.69 (0.64)	0.96 (0.71-1.31)	0.86 (0.62-1.20)
Retired, Disabled, Other	<b>0.39***</b> <b>(0.32-0.47)</b>	<b>-1.83**</b> <b>(0.57)</b>	0.89 (0.67-1.19)	0.63 (0.48-0.83)
Education level				
<Primary school <sup>1</sup>	1.00	--	1.00	1.00
<High school	1.01 (0.83-1.23)	-0.81 (0.58)	<b>0.66**</b> <b>(0.49-0.89)</b>	0.79 (0.60-1.04)
High school/ Tech.& Voc. school	<b>1.48**</b> <b>(1.16-1.88)</b>	-1.01 (0.69)	<b>0.57**</b> <b>(0.40-0.81)</b>	0.75 (0.54-1.04)
College degree or higher	<b>1.46*</b> <b>(1.03-2.08)</b>	-1.06 (0.96)	<b>0.53**</b> <b>(0.33-0.84)</b>	0.70 (0.43-1.13)
Mean per capita log HH income (in 1000 RMBs) <sup>2</sup>	1.05 (0.98-1.12)	-0.12 (0.18)	<b>1.11*</b> <b>(1.01-1.21)</b>	1.02 (0.93-1.11)
Urban/Rural				
Urban <sup>1</sup>	1.00	--	1.00	1.00
Rural	<b>0.61***</b> <b>(0.46-0.80)</b>	1.36 (0.74)	1.10 (0.79-1.53)	1.09 (0.79-1.52)
Density (Square Root)	1.00 (1.00-1.00)	0.00 (0.01)	1.00 (1.00-1.00)	1.00 (1.00-1.00)

Note: Asterisks indicate \*\*\* $P < 0.001$ , \*\* $P < 0.01$ , \* $P < 0.05$ ; 1. Reference group



Table 5. Cost: Multilevel logistic regression analysis of the association between average cost of local beer and alcohol consumption

	Alcohol Consumption Measures			
	Current drinking OR (95% CI)	Weekly alcohol consumption $\beta$ (SE)	Frequent drinking OR (95% CI)	Heavy drinking OR (95% CI)
Average cost of local beer	1.02 (0.99-1.06)	<b>-0.35**</b> (0.10)	<b>0.94*</b> (0.89-0.99)	<b>0.92**</b> (0.87-0.97)
Gender				
Male <sup>1</sup>	1.00	--	1.00	1.00
Female	<b>0.01***</b> (0.01-0.02)	<b>-6.88***</b> (0.47)	<b>0.15***</b> (0.12-0.19)	<b>0.50***</b> (0.39-0.63)
Age, year				
18-25 y <sup>1</sup>	1.00	--	1.00	1.00
26-35 y	<b>1.56**</b> (1.19-2.05)	1.42 (0.86)	<b>2.02***</b> (1.40-2.91)	<b>2.01**</b> (1.19-3.39)
36-45 y	<b>1.87***</b> (1.41-2.47)	<b>3.48**</b> (0.87)	<b>3.23***</b> (2.22-4.71)	<b>3.27***</b> (1.94-5.48)
46-55 y	<b>1.81***</b> (1.37-2.40)	<b>5.25***</b> (0.88)	<b>4.35***</b> (2.96-6.38)	<b>4.78***</b> (2.84-8.04)
56+ y	1.19 (0.88-1.59)	<b>5.29***</b> (0.92)	<b>4.30***</b> (2.87-6.42)	<b>4.72***</b> (2.76-8.06)
Marital status				
Never married <sup>1</sup>	1.00	--	1.00	1.00
Married	<b>1.73***</b> (1.35-2.22)	1.45 (0.76)	<b>1.69**</b> (1.22-2.33)	1.41 (0.93-2.14)
Divorced/Separated/Widowed	<b>1.46*</b> (1.06-2.02)	0.92 (1.01)	<b>2.19**</b> (1.39-3.45)	1.40 (0.83-2.35)
Employment status				
Working <sup>1</sup>	1.00	--	1.00	1.00
Seeking work, Student, Housework	<b>0.60***</b> (0.51-0.69)	-1.03 (0.53)	1.08 (0.85-1.37)	0.84 (0.64-1.09)
Retired, Disabled, Other	<b>0.48***</b> (0.41-0.56)	<b>-1.77***</b> (0.46)	1.03 (0.82-1.28)	0.68 (0.54-0.84)
Education level				
<Primary school <sup>1</sup>	1.00	--	1.00	1.00
<High school	1.00 (0.85-1.16)	-0.39 (0.49)	<b>0.76*</b> (0.60-0.97)	0.87 (0.70-1.09)
High school/ Tech.& Voc. school	<b>1.31**</b> (1.08-1.59)	-0.38 (0.58)	<b>0.73*</b> (0.56-0.96)	0.78 (0.60-1.03)
College degree or higher	<b>1.51**</b> (1.13-2.01)	-1.24 (0.82)	<b>0.61**</b> (0.42-0.88)	0.70 (0.47-1.04)
Mean per capita log HH income (in 1000 RMBs) <sup>2</sup>	<b>1.09**</b> (1.03-1.14)	-0.08 (0.15)	1.07 (1.00-1.15)	1.03 (0.97-1.12)
Urban/Rural				
Urban <sup>1</sup>	1.00	--	1.00	1.00
Rural	<b>0.57***</b> (0.45-0.72)	<b>1.41*</b> (0.65)	1.21 (0.91-1.61)	1.17 (0.88-1.55)
Density (Square Root)	1.00 (1.00-1.00)	-0.01 (0.01)	1.00 (1.00-1.00)	1.00 (1.00-1.00)

Note: Asterisks indicate \*\*\* $P$ <0.001, \*\* $P$ <0.01, \* $P$ <0.05; 1. Reference group

Table 6. Cost: Multilevel logistic regression analysis of the association between average cost of local liquor and alcohol consumption

	Alcohol Consumption Measures			
	Current drinking OR (95% CI)	Weekly alcohol consumption $\beta$ (SE)	Frequent drinking OR (95% CI)	Heavy drinking OR (95% CI)
Average cost of local liquor	<b>1.01**</b> <b>(1.00-1.02)</b>	0.00 (0.02)	1.00 (0.98-1.00)	1.00 (0.99-1.01)
Gender				
Male <sup>1</sup>	1.00	--	1.00	1.00
Female	<b>0.01***</b> <b>(0.01-0.02)</b>	<b>-6.91***</b> <b>(0.48)</b>	<b>0.15***</b> <b>(0.12-0.19)</b>	<b>0.49***</b> <b>(0.38-0.62)</b>
Age, year				
18-25 y <sup>1</sup>	1.00	--	1.00	1.00
26-35 y	<b>1.63**</b> <b>(1.24-2.16)</b>	<b>1.51</b> <b>(0.88)</b>	<b>1.91**</b> <b>(1.32-2.77)</b>	<b>2.15**</b> <b>(1.26-3.69)</b>
36-45 y	<b>1.98***</b> <b>(1.49-2.63)</b>	<b>3.47***</b> <b>(0.89)</b>	<b>3.07***</b> <b>(2.10-4.49)</b>	<b>3.38***</b> <b>(1.98-5.77)</b>
46-55 y	<b>1.88***</b> <b>(1.41-2.51)</b>	<b>5.28***</b> <b>(0.94)</b>	<b>4.21***</b> <b>(2.85-6.20)</b>	<b>5.11***</b> <b>(2.99-8.73)</b>
56+ y	1.30 (0.97-1.76)	<b>5.27***</b> <b>(0.94)</b>	<b>4.15***</b> <b>(2.87-6.42)</b>	<b>4.97***</b> <b>(2.86-8.62)</b>
Marital status				
Never married <sup>1</sup>	1.00	--	1.00	1.00
Married	<b>1.68***</b> <b>(1.30-2.16)</b>	1.35 (0.77)	<b>1.70**</b> <b>(1.22-2.36)</b>	1.32 (0.86-2.03)
Divorced/Separated/Widowed	<b>1.40*</b> <b>(1.01-1.94)</b>	0.73 (1.03)	<b>2.04**</b> <b>(1.30-3.22)</b>	1.31 (0.77-2.22)
Employment status				
Working <sup>1</sup>	1.00	--	1.00	1.00
Seeking work, Student, Housework	<b>0.59***</b> <b>(0.50-0.69)</b>	-0.88 (0.54)	1.10 (0.87-1.40)	0.86 (0.66-1.13)
Retired, Disabled, Other	<b>0.47***</b> <b>(0.40-0.55)</b>	<b>-1.53**</b> <b>(0.47)</b>	1.02 (0.81-1.27)	<b>0.70**</b> <b>(0.56-0.88)</b>
Education level				
<Primary school <sup>1</sup>	1.00	--	1.00	1.00
<High school	1.00 (0.85-1.17)	-0.33 (0.49)	<b>0.75*</b> <b>(0.60-0.95)</b>	0.87 (0.70-1.09)
High school/ Tech.& Voc. school	<b>1.36**</b> <b>(1.11-1.65)</b>	-0.36 (0.59)	<b>0.71*</b> <b>(0.54-0.93)</b>	0.77 (0.59-1.02)
College degree or higher	<b>1.56**</b> <b>(1.17-2.09)</b>	-1.23 (0.83)	<b>0.60**</b> <b>(0.41-0.87)</b>	0.71 (0.47-1.07)
Mean per capita log HH income (in 1000 RMBs) <sup>2</sup>	<b>1.10***</b> <b>(1.04-1.15)</b>	-0.08 (0.15)	1.08 (1.00-1.15)	1.04 (0.97-1.12)
Urban/Rural				
Urban <sup>1</sup>	1.00	--	1.00	1.00
Rural	<b>0.56***</b> <b>(0.45-0.71)</b>	<b>1.64*</b> <b>(0.65)</b>	1.21 (0.91-1.61)	1.22 (0.92-1.63)
Density (Square Root)	1.00 (1.00-1.00)	-0.01 (0.01)	1.00 (1.00-1.00)	1.00 (1.00-1.00)

Note: Asterisks indicate \*\*\* $P$ <0.001, \*\* $P$ <0.01, \* $P$ <0.05; 1. Reference group

Table 7. Cost: Multilevel logistic regression analysis of the association between average cost of aged liquor and alcohol consumption

	Alcohol Consumption Measures			
	Current drinking OR (95% CI)	Weekly alcohol consumption $\beta$ (SE)	Frequent drinking OR (95% CI)	Heavy drinking OR (95% CI)
Average cost of aged liquor	1.00 (1.00-1.00)	<b>-0.02*</b> (0.01)	1.00 (0.99-1.00)	<b>0.995**</b> (0.99-1.00)
Gender				
Male <sup>1</sup>	1.00	--	1.00	1.00
Female	<b>0.01***</b> (0.01-0.02)	<b>-6.83***</b> (0.50)	<b>0.15***</b> (0.11-0.19)	<b>0.48***</b> (0.37-0.63)
Age, year				
18-25 y <sup>1</sup>	1.00	--	1.00	1.00
26-35 y	<b>1.41*</b> (1.04-1.90)	1.28 (0.96)	<b>1.66*</b> (1.09-2.51)	<b>1.90*</b> (1.06-3.38)
36-45 y	<b>1.75***</b> (1.29-2.38)	<b>2.99**</b> (0.97)	<b>2.91***</b> (1.89-4.48)	<b>2.63**</b> (1.48-4.67)
46-55 y	<b>1.67**</b> (1.23-2.28)	<b>4.74***</b> (0.97)	<b>4.05***</b> (2.61-6.27)	<b>4.06***</b> (2.28-7.22)
56+ y	1.08 (0.78-1.49)	<b>4.48***</b> (1.02)	<b>3.92***</b> (2.48-6.20)	<b>4.07***</b> (2.25-7.38)
Marital status				
Never married <sup>1</sup>	1.00	--	1.00	1.00
Married	<b>1.75***</b> (1.33-2.29)	1.41 (0.84)	<b>1.58*</b> (1.09-2.29)	1.43 (0.90-2.29)
Divorced/Separated/Widowed	1.34 (0.94-1.92)	1.26 (1.12)	<b>2.08**</b> (1.24-3.51)	1.52 (0.85-2.73)
Employment status				
Working <sup>1</sup>	1.00	--	1.00	1.00
Seeking work, Student, Housework	<b>0.56***</b> (0.47-0.66)	-0.85 (0.58)	0.98 (0.75-1.28)	0.82 (0.61-1.10)
Retired, Disabled, Other	<b>0.48***</b> (0.41-0.57)	<b>-1.62**</b> (0.49)	1.00 (0.79-1.27)	<b>0.64***</b> (0.50-0.81)
Education level				
<Primary school <sup>1</sup>	1.00	--	1.00	1.00
<High school	1.05 (0.88-1.24)	-0.80 (0.53)	0.78 (0.60-1.01)	0.82 (0.64-1.05)
High school/ Tech.& Voc. school	<b>1.39**</b> (1.13-1.72)	-0.82 (0.63)	<b>0.68*</b> (0.50-0.93)	<b>0.72*</b> (0.53-0.96)
College degree or higher	<b>1.58**</b> (1.17-2.14)	-1.26 (0.87)	<b>0.61*</b> (0.41-0.91)	0.69 (0.45-1.07)
Mean per capita log HH income (in 1000 RMBs) <sup>2</sup>	<b>1.08***</b> (1.02-1.15)	-0.16 (0.17)	1.06 (0.98-1.15)	1.00 (0.92-1.08)
Urban/Rural				
Urban <sup>1</sup>	1.00	--	1.00	1.00
Rural	<b>0.57***</b> (0.44-0.73)	1.13 (0.70)	1.11 (0.81-1.51)	1.11 (0.82-1.50)
Density (Square Root)	<b>1.00*</b> (1.00-1.00)	<b>-0.01*</b> (0.01)	1.00 (1.00-1.00)	1.00 (1.00-1.00)

Note: Asterisks indicate \*\*\* $P < 0.001$ , \*\* $P < 0.01$ , \* $P < 0.05$ ; 1. Reference group

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**Paper 3:**  
**Alcohol Consumption**  
**and Healthcare Utilization in China**

## Abstract

**Purpose:** Excessive alcohol consumption is a worldwide social problem that has greatly contributed to the global burden of disease, disability and death. Problematic alcohol consumption has been linked to increased risk of several fatal and non-fatal diseases. Yet, research in Western countries examining healthcare utilization among at-risk, frequent, and heavy alcohol drinkers, or those who meet the diagnostic criteria for alcohol abuse or dependence, has found that these types of alcohol drinking patterns are generally associated with decreased healthcare utilization, or exhibit no detectable association with healthcare utilization at all. This indicates a tendency for under-utilization of healthcare services among those drinkers who likely require increased healthcare and attention. However, there have been no studies that have examined the relationship between alcohol consumption and healthcare utilization in China. The current study examines the relationship between alcohol consumption behaviors and healthcare utilization in China, and whether the negative-dose relationship between alcohol consumption and healthcare utilization and the tendency for lower utilization of health services among frequent and heavy drinkers also exists for the Chinese population.

**Methods:** Using data from the 2009 China Health and Nutrition Survey (N=18,917), this study used three-level logistic regression analyses to examine the cross-sectional relationship between three aspects of healthcare utilization (formal medical care utilization – including both inpatient and outpatient medical services, use of folk doctors, and receipt of preventative healthcare services) and three measures of alcohol consumption behaviors (quantity of alcoholic beverages consumed per week, frequency of drinking, and heavy drinking). The association between healthcare utilization and socio-demographic and other characteristics, such as rural/urban location and medical insurance status, were also examined.

**Results:** The percentages of respondents reporting using formal medical care in the past four weeks, using preventive healthcare services in the past four weeks, and visiting a folk doctor in the past year were 1.16, 4.03, and 4.33%, respectively. In the unadjusted analysis, frequent drinkers were significantly less likely to have sought formal medical care [OR=0.46 (95% CI: 0.23-0.91)] and to have received preventive healthcare services [OR=0.60 (95% CI: 0.43-0.84)] compared to infrequent drinkers. After adjusting for socio-demographic and other characteristics, none of the alcohol consumption variables were found to be significantly associated with any of the three aspects of healthcare utilization. Across all unadjusted and adjusted analyses, rural residents were found to be significantly less likely to use preventive healthcare services compared to their urban counterparts.

**Implications:** These findings suggest that problematic drinkers in China under-utilize preventive healthcare services and possibly formal medical care in general. The under-utilization of preventive healthcare services that can screen and provide early detection of chronic diseases associated with problematic alcohol use is particularly concerning for this at-risk drinking group since diseases may be only detected at more advanced, and costly, stages. Health policy initiatives informing the Chinese public of the health risks of excessive alcohol consumption and the importance of preventive healthcare service use among drinkers can help reduce at-risk and other problematic patterns of drinking, as well as encourage increased utilization of cost-saving, and life-saving, healthcare services. These findings also indicate that

individuals residing in rural areas are low utilizers of preventive healthcare services; future research should identify whether low utilization is due to lack of availability of preventive healthcare services or lack of awareness of the importance of preventive healthcare in rural areas. In either case, preventive healthcare promotion in rural areas should be a policy priority in China.

## Introduction

Excessive alcohol consumption is a worldwide social problem that has greatly contributed to the global burden of disease, disability and death (Degenhardt et al., 2008; Rehm et al., 2009; Room, Babor, & Rehm, 2005; WHO, 2014). As a causal factor for more than 60 types of diseases and injuries and representing the third highest risk factor for disease and disability, alcohol consumption results in 2.5 million or almost 4% of global deaths each year, more than those caused by HIV/AIDS, violence, or tuberculosis (WHO, 2014). Problem alcohol consumption has been linked to increased risk of several fatal and non-fatal diseases, including various types of cancer, diabetes, coronary and cardiovascular diseases, and liver cirrhosis (Boffetta, Hashibe, La Vecchia, Zatonski, & Rehm, 2006; Goldberg, Burchfiel, Reed, Wergowske, & Chiu, 1994; Marmot, Shipley, Rose, & Thomas, 1981; Murray et al., 2002; Rehm et al., 2009). Yet, research in Western countries examining healthcare utilization among problematic, heavy, and frequent alcohol drinkers, or those who meet the diagnostic criteria for alcohol abuse or dependence, has found that these types of alcohol drinking patterns are generally associated with decreased healthcare utilization, if any significant association is found at all (Baumeister et al., 2006a; Baumeister et al., 2006b; Ford, Trestman, Tennen, & Allen, 2005; Heise, 2010; Jenkins & Zucker, 2010; Ogborne & DeWit, 2001; Polen, Green, Freeborn, Mullooly, & Lynch, 2001; Rice et al., 2000; Rodriguez-Artalejo et al., 2000; Yan, Xu, Ettner, Barnes, & Moore, 2014; Zarkin, Bray, Babor, & Higgins-Biddle, 2004). This relationship between alcohol drinking patterns and healthcare utilization, given the increased risk and incidence of health problems, is counterintuitive and indicates a tendency for under-utilization of healthcare services among those drinkers who likely require increased healthcare and attention compared to abstainers or alcohol drinkers who do not exhibit problematic drinking patterns.

However, there have been no studies that have examined the relationship between alcohol consumption and healthcare utilization in China. Historically, overall volume of alcohol consumption, and consequently the prevalence of alcohol-related health problems, in China have remained relatively low in comparison to many Western countries (Cochrane, Chen, Conigrave, & Hao, 2003; Hao, Derson, Shuiyuan, Lingjiang, & Yalin, 1999). A growing body of research indicates that alcohol consumption in China has sharply increased in recent years (Cochrane et al., 2003; Hao et al., 1999; Hao et al., 2004; Hao, Chen, & Su, 2005; Li et al., 2011; Millwood et al., 2013). Additionally, incidence of non-fatal chronic diseases associated with alcohol consumption in China is also on the rise (Gao et al., 1994; Hao et al., 2004; Yuan, Ross, Gao, Henderson, & Yu, 1997; Zhou et al., 2003). Given the changing alcohol drinking patterns and the growth of alcohol-related health and other problems in China, this study examines the relationship between alcohol consumption behaviors and healthcare utilization in China, and seeks to answer the question about whether the tendency for lower utilization of health services among problem drinkers also exists for the Chinese population. Knowledge in this area can identify intervention and health policy needs for persons at risk for the development of costly chronic diseases.

### Health Effects of Alcohol Consumption

An extensive and well-established scholarship has examined the relationship between alcohol consumption and health outcomes. Several studies have found that light or moderate alcohol drinkers exhibited reduced risk of certain diseases and health events, such as diabetes mellitus, cardiovascular disease, coronary heart disease, and stroke, in comparison to lifetime

abstainers (Baliunas et al., 2009; Marmot et al., 1981; Murray et al., 2002; Reynolds et al., 2003; Ronksley, Brien, Turner, Mukamel, & Ghali, 2011). However, research overwhelmingly indicates that heavy and binge drinking are associated with increased risk of developing these diseases, as well as various types of cancer and neuropsychiatric disorders. (Baliunas et al., 2009; Carrao, Bagnardi, Zambon, & Arico, 1999; Carrao, Bargardi, Zambon, & La Vecchia, 2004; Goldberg et al., 1994; Marmot et al., 1981; Murray et al., 2002; Reynolds et al., 2003; Rehm et al., 2009, Ronksley et al., 2011; Room et al., 2005).

Research findings regarding health outcomes associated with frequent drinking are far more mixed in comparison to those associated with heavy and binge drinking; frequent drinking has been found to be associated with both increased and decreased risk of disease and deleterious health outcomes. On the one hand, frequency of alcohol consumption has been found to be inversely associated with risk of coronary heart disease and myocardial infarction and coronary death (McElduff & Dobson, 1997; Mukamel et al., 2003; Mukamel et al., 2005), as well as diabetes (Conigrave et al., 2001), with drinking at least four days a week contributing to lower risk. However, Anttila and colleagues (2004) found frequent drinking, or drinking several times a month, in middle age to be associated with cognitive impairment in later life, and Russell and colleagues (1991) found that low blood pressure was associated with infrequent (less than weekly) drinking, rather than frequent drinking of small amounts of alcohol.

One factor that may contribute to these mixed findings on the health effects of frequent drinking is that frequent drinking is associated with lower incidence of some diseases and health outcomes, while contributing to higher incidence of others (Edwards et al., 1994). For example, Breslow and Graubard (2008) found in the same study that the highest drinking frequency quartile (compared to the lowest) had lower relative risk for cardiovascular disease for men, but higher relative risk of cancer for men and women. A number of studies have also questioned the cardioprotective effects of moderate alcohol consumption, citing the conflation of lifetime abstainers with former drinkers (Fillmore, Kerr, Stockwell, Chikritzhs, & Bostrom, 2006) and the possibility that this relationship may be spurious and perhaps due to unmeasured confounding risk factors, such as “mental health, socioeconomic position in early life, psychosocial characteristics, social networks, sources of emotional support,” and others (Baumeister et al., 2006b; Fuchs & Chambliss, 2007, p. 401). More recently, studies examining the genetic factors associated with protective health effects of moderate drinking found genetic variants to be modifiers of the association (Holmes et al., 2014; Mehlig et al., 2014); Mehlig and colleagues (2014) estimate that the prevented fraction for the favorable combination of alcohol consumption and genotype to be 6%, suggesting that the cardio-protective effect of moderate alcohol consumption to be applicable to a very small percentage of the general population.

Similar to findings in Western-based literature, heavy alcohol consumption has been found to be associated with numerous detrimental health effects for the Chinese population (Gao et al., 1994; Hao et al., 2004; Yuan et al., 1997; Zhou et al., 2003). In a prospective study examining the relationship between mortality and alcohol consumption in Shanghai, heavy drinking was found to be significantly associated with increased risk of stomach cancer, liver cirrhosis, and stroke (Yuan et al., 1997). Hao and colleagues (2004) found that the 1-year morbidity of gastritis/ulcer, migraine, disc/back pain, and insomnia was higher in drinkers than in non-drinkers, whereas heart disease and cerebral infarction/cerebral hemorrhage showed a V-shaped curve relationship. According to the World Health Organization, the years of life lost (YLL) attributable to alcohol (i.e., the average number of additional years a person would have

lived if he or she had not died prematurely) in China is ranked in the fourth highest quintile, the same as the United States (WHO, 2014).

### **Alcohol Consumption and Healthcare Utilization**

These findings that problematic alcohol consumption contributes to poorer health and increased risk for disease suggest that heavy and possibly frequent drinkers should be likely to use more healthcare services than light and infrequent drinkers, and that there should be a positive relationship between levels of alcohol consumption and healthcare utilization. However, the research examining the association between alcohol consumption and healthcare utilization, originating primarily in Western countries, has generally found either an inverse relationship or no significant differences in healthcare utilization between abstainers and drinkers, and between problem and non-problem drinkers (Baumeister et al., 2006a; Baumeister et al., 2006b; Ford et al., 2005; Heise, 2010; Jenkins & Zucker, 2010; Ogborne & DeWit, 2001; Polen et al., 2001; Rice et al., 2000; Rodriguez-Artalejo et al., 2000; Yan et al., 2014; Zarkin et al., 2004). In a study conducted in the United States, Zarkin and colleagues (2004) found that current, frequent, and heavy drinkers were significantly less likely to have outpatient medical visits, use inpatient hospital services, or visit the hospital emergency department compared to abstainers, with an overall pattern of more extensive drinking patterns associated with less healthcare utilization. In other studies conducted in the United States, binge drinking (Jenkins and Zucker, 2010) and alcohol use disorders (Ford et al., 2005) were negatively associated with utilization of outpatient medical care. Similarly, Rodriguez-Artalejo and colleagues (2000) found a negative dose response between weekly alcohol consumption and outpatient medical visits, inpatient hospital services, and emergency department visits in Spain.

However, a study conducted in Germany found that though medium risk drinkers (determined by amount of alcohol consumed per day calculated by quantity-frequency measures) were significantly less likely to use outpatient medical/physician visits and inpatient hospital services than low-risk drinkers, no significant differences in the utilization of these healthcare services were found when comparing high and low risk drinkers (Baumeister et al., 2006a). A number of other studies also reported mixed findings. In a United States-based study, Heise (2010) found that low and high risk drinkers, determined in the study by the number of days in the past year a person consumed 5 or more drinks, were less likely to use healthcare, including outpatient, inpatient, and emergency department care in bivariate analyses, however, these differences were no longer significant when socio-demographic and others factors were added to the analyses. Ogborne and DeWit (2001) found that only daily moderate drinkers were less likely to use inpatient hospital services when compared to lifetime abstainers, but found no evidence of significant differences between different types of drinkers, including heavy and regular drinkers, for general practitioner and emergency department visits in Canada.

Finally, several studies found no strong consistent relationships between multiple drinking patterns or alcohol consumption levels and outpatient medical care (Cherpitel, Soghikian, & Hurley, 1996; Polen et al., 2001; Reid et al., 2000), inpatient hospitalization (Cherpitel et al., 1996; Polen et al., 2001; Reid et al., 2000), and emergency department visits (Polen et al., 2000) in the United States. In summary, these findings of negative or lack of association between different indicators of alcohol consumption/problems and healthcare use indicate an overall trend of underutilization of healthcare services among problem drinkers, who should be significantly more likely to use healthcare services given the evidence of their increased risk for disease and poor health.

Another important consideration in investigating the association between healthcare utilization and alcohol consumption is the role of preventive healthcare service use. Given the relationship between problematic alcohol consumption and deleterious health outcomes, preventive healthcare services, such as cancer screening, blood pressure monitoring, and routine physical exams, can aid in early detection of disease in persons who are at risk due to their alcohol consumption patterns. Similarly to research regarding other healthcare use, studies in Western countries specifically examining preventive healthcare use and health promotion activities overwhelmingly show that excessive, harmful, heavy, and/or frequent drinking is associated with less use of these types of services (Ettner, French, & Popovici, 2010; Galán et al., 2006; Green et al., 2010; Merrick et al., 2008; Moore et al., 2001; Paul, Grubaugh, Frueh, Ellis, & Egede, 2011; Rabiner, Branch, & Sullivan, 1999; Urbanoski, 2003).

Very few studies investigating the relationship between healthcare utilization and alcohol consumption have been conducted in East Asian countries. However, these do mirror the findings in Western countries; Anzai and colleagues (2005) found an inverse relationship between outpatient physician visits and alcohol consumption among adults in Japan, while Kwon and colleagues (2009) found that screening for gastric cancer was negatively associated with alcohol consumption among adults in Korea. Still, there is a lack of research of this kind that has been conducted in China.

The purpose of this study is to examine overall effects of alcohol consumption behaviors on healthcare utilization among adults in China, and if there exists a relationship between frequent drinking, heavy drinking, and levels of alcohol consumption with use of different types of healthcare services. The findings from this area of inquiry can determine if underutilization of health services among problem drinkers that has been found in Western countries also exist in China, in order identify intervention and health policy needs for persons at risk for the development of costly chronic diseases. The main objective of this study is to analyze the relationship between three measures of alcohol consumption (amount of alcohol consumed weekly, frequent drinking, and heavy drinking) and the three types of healthcare services most commonly used among the Chinese population and that are included in the study data (formal medical care utilization – including both inpatient and outpatient services, receipt of preventive healthcare services, and use of folk doctors<sup>4</sup>).

A second objective of this study is to examine other characteristics that have been theorized to influence healthcare services utilization, according to Andersen's Behavioral Model of Health Services Utilization (Andersen, 1995). Specifically, Andersen proposed that a number of factors that influence a person's likelihood to use healthcare services: (1) predisposing characteristics; (2) enabling characteristics; and (3) need-based characteristics (see Figure 1). Predisposing characteristics include demographic factors that represent "biological imperatives suggesting that people will need health services, such as age and gender", as well as social structure factors that "determine the status of a person in the community, his or her ability to cope with presenting problems and commanding resources to deal with these problems," such as education level and employment status (Andersen, 1995, p. 2). Health beliefs, which are "the attitudes, values, and knowledge that people have about health services", are also predisposing characteristics, though not included in this study's analyses since these data were not collected (Andersen, 1995, p. 2). Secondly, enabling characteristics include familial and community resources that facilitate use of healthcare services, such as income and health insurance. Finally,

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<sup>4</sup> Service providers associated with informal medical care, and typically work in private hospitals, are not licensed, and have only limited medical training



need-based characteristics include both individually perceived needs and clinically evaluated needs for healthcare. In this model, alcohol use behaviors represent a possible need-based characteristic for healthcare utilization. A subsequent expanded model includes characteristics of the health care system, such as health policy, labor and capital resources, and organization of the healthcare system, and consumer satisfaction with the convenience, quality, and other aspects of the health care provision. Because these were not measured in the study, they could not be included in the statistical analyses but have important implications in the study findings.

Thus, this study seeks to answer the following research questions: (1) Does alcohol consumption have an effect on these three aspects of healthcare utilization in China, and if so, what is the direction of the relationship? (2) What socio-demographic and other characteristics affect these three aspects of healthcare utilization in China?

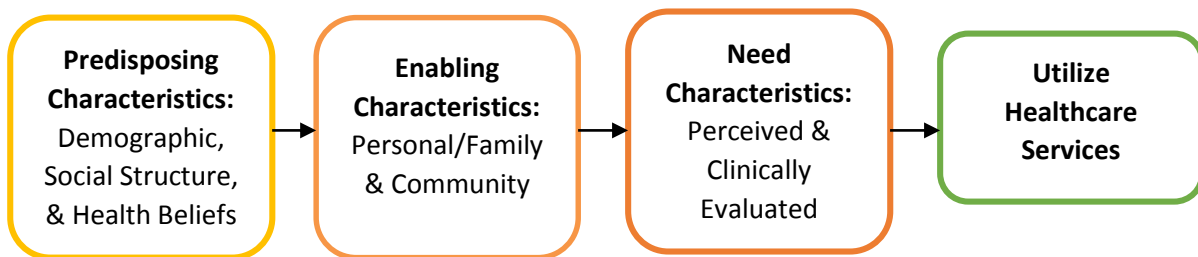


Figure 1: Andersen's Behavioral Model of Health Services (adapted from Andersen, 1995)

## Methods

### Study Sample

This research uses publicly available datasets from the China Health and Nutrition Survey (CHNS). The CHNS is an “an ongoing international collaborative project between the Carolina Population Center at the University of North Carolina at Chapel Hill and the National Institute of Nutrition and Food Safety at the Chinese Center for Disease Control and Prevention, ...designed to examine the effects of the health, nutrition, and family planning policies and programs implemented by national and local governments and to see how the social and economic transformation of Chinese society is affecting the health and nutritional status of its population” (CHNS, n.d.). The survey was first administered in 1989, with eight additional panels collected in 1991, 1993, 1997, 2000, 2004, 2006, 2009, and 2011. Data for the variables of interest for survey year 2011 are not available currently. The most recent survey consists of seven sections which have been developed over time: household survey (including survey items pertaining to household characteristics), health services, individual survey, nutrition and physical examination, community survey, food market survey, and health and family planning facility.

The CHNS study population was drawn from nine Chinese provinces: Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Liaoning, and Shandong (see Figure 2). The study locations did not include the most interior provinces of China, which are less economically developed than the coastal and near-coastal regions, and consequently, the samples are not nationally representative (Fujita & Hu, 2001). However, the participating provinces do include northern, central, and southern provinces and are socioeconomically and demographically diverse. The CHNS research team stratified counties in the nine participating provinces by income (low, middle, and high), and a multi-stage, cluster weighted sampling process was used to randomly select 4 counties in each province. The provincial capital and a lower income city

within each province were selected when possible. Within each county/city, villages, townships, and urban and suburban neighborhoods were then selected randomly. From these sampling units, twenty randomly chosen households were selected and all adults (ages 18 and over) within the households were interviewed. Beginning in 1997, new participants were recruited as replenishment samples “if a community has less than 20 households or if participants have formed a new household or separated from their family into a new housing unit in the same community” (Popkin, Du, Zhai, & Zhang, 2009, p. 1437). Also in 1997, the Liaoning province was not able to participate and the Heilongjiang province was added. In 2000 and in subsequent survey years, both Liaoning and Heilongjiang provinces were surveyed. Figure 2 shows the participating regions in the 2009 survey.

The survey was administered using face-to-face interviews. Typically, the interview team stayed within a community for four or more days and visited each household daily to collect data. Interviews lasted from half an hour to one hour per household for each of the days of data collection. Each household was given a gift of five to twenty dollars as an incentive. Given the complex nature of recruitment, such as replenishment samples, province dropout and return, and individual dropout and return, response rates and attrition for the survey across all study years are difficult to determine (Popkin et al, 2010).



Figure 2: From: China Health and Nutrition Survey, n.d.

This study uses data from the 2009 survey wave, the most recent year for which alcohol consumption data are available. This survey wave included 216 primary sampling units: 36 urban neighborhoods, 36 suburban neighborhoods, 36 towns and 108 villages. A total of 18,917 individuals were interviewed.

### Dependent Variables

The key dependent variables consist of three aspects of general and outpatient healthcare utilization: (1) seeking any formal medical care in the past four weeks (including outpatient and inpatient services); (2) receiving preventive health services, such as health examination, eye

examination, blood test, blood pressure screening, and cancer screening, in the past four weeks; and (3) and visiting a folk doctor (i.e., service providers associated with informal medical care, and typically work in private hospitals, are not licensed, and have only limited medical training) in the past year (Lei & Lin, 2009; Yang, 2013). All dependent variables are dichotomous, coded as yes=1 and no=0.

### **Independent Variables**

The key independent variables consist of the three measures of alcohol consumption: (1) quantity of alcoholic beverages consumed per week; (2) frequency of drinking; and (3) heavy drinking. The first measure was derived from survey items about the types of alcohol consumed (beer, wine, and liquor) and the amount of each type consumed per week. Responses were reported in units of number of bottles per week for beer, and number of liangs (50 gm) per week for wine and liquor. These units were converted to approximate standard drink sizes, as defined by the National Institute on Alcohol Abuse and Alcoholism (NIAAA, n.d.), if possible. Units of wine were converted to three liangs (approximately 5 oz.), units of liquor remained as one liang (approximately 1.5 oz.), and units of beer remained as one bottle, given the limitation of this measurement unit and with the assumption that the average size of a bottle of beer is 12 oz. The units for each type of alcoholic beverage were summed to provide number of standard drinks consumed weekly. The second measure was based on the survey question “How often do you drink beer or any alcoholic beverage,” with the following available response choices: almost every day, 3-4 times a week, once or twice a week, once or twice a month, or no more than once a month. Responses indicating drinking at least once per week or more were coded as frequent drinking, whereas responses indicating drinking twice a month or less were coded as infrequent drinking, based on categories using a modified version of Cahalan, Roizen, and Room's (1976) Quantity-Frequency Index (QF) set forth by NIAAA (2005). Specifically, NIAAA (2005) defined frequent drinking as “drinks at least once a week, and may or may not drink 5 or more drinks at a sitting less than once a week but at least once a year”.<sup>1</sup> In the absence of survey data regarding number of drinks consumed per sitting/drinking occasion, this measure could only be based on the frequency component of this definition. The third measure was constructed to compare non-heavy drinkers with heavy drinkers, as defined by NIAAA (n.d.), for which responses indicating more than 7 drinks per week for women and more than 14 drinks per week for men were coded as heavy drinking.

Covariates include predisposing characteristics (gender, age, employment status, and education level), enabling characteristics (marital status, urban/rural location, per capita household income, and medical insurance status), and need-based characteristics (current smoking status and sickness/injury in the past four weeks). Gender, urban/rural location, medical insurance status, current smoking status, and sickness/injury in the past four weeks are dichotomous variables. Per capita annual household income is a continuous variable that was converted to 1000 renminbi (RMB) units and transformed to the log scale in order to make the findings more interpretable and negative values were recoded to missing. Age was grouped into five categories: 18-25, 26-35, 36-45, 46-55, and 56+ years. Marital status was classified into three categories: never married, married, and divorced/separated/widowed. Employment status

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<sup>1</sup> Other categories are the following: “Abstainer” defined as “never drinks, or drinks less than once a year”; “Less frequent” defined as “drinks 1 to 3 times a month, and may or may not drink 5 or more drinks, at least once a year”, and “Frequent heavy drinker” defined as “drinks at least once a week, and has 5 or more drinks at one sitting at least once per week”. <http://pubs.niaaa.nih.gov/publications/Social/Module1Epidemiology/Module1.html>

was classified into two categories, currently employed and not working, which included those respondents seeking work, doing housework, student, retired, and disabled/other. Education level was classified into four categories: less than primary school graduate, less than high school graduate, high school graduate and technical/ vocational school graduate, and college graduate and above.

## Analysis

Descriptive statistics were performed to examine general socio-demographic characteristics of the study sample (see Table 1), alcohol consumption behaviors and levels (see Table 2), and healthcare utilization behaviors (see Table 3).

In order to understand the relative impact of different confounders and effect modifiers, three successive sets of models were estimated to examine the association between each of the three key alcohol consumption independent variables (weekly alcohol consumption, frequent drinking, and heavy drinking) and each of the three healthcare utilization dependent variables (seeking formal medical care, receiving preventive health services, and visiting a folk doctor). To control for the multi-level, multi-stage sampling design effects of the CHNS, three-level logistic random intercept models were used in each analyses, where the individual was nested within the household, and the household was nested within the community. For the first set of models, three-level logistic regressions including only alcohol consumption independent variables were performed. The second set of models used multivariate three-level logistic regressions to examine the effect of alcohol consumption on healthcare utilization, controlling for socio-demographic and other confounding variables. Degree of freedom tests and ANOVAs were conducted to test the categorical independent variables, which indicated the statistical significance of the categories included in the analyses. For analyses examining formal medical care use in the past four weeks, sickness/injury in the past four weeks was also included as an independent control variable. Finally, because current smoking is highly correlated with drinking, determined by using Pearson's Correlation ( $r(10,599) = 0.44, p < .0001$ ), its inclusion in regression models may partially mask the full effect of alcohol use on healthcare utilization (as discussed by Zarkin et al., 2004). Therefore the third set of models included all covariates in multivariate three-level logistic regression analyses except for current smoking status. A total of twenty-seven separate logistic regressions were performed. All statistical analyses were conducted using STATA version 13.0.

## Results

Table 1 presents the general socio-demographic characteristics of the study population. In summary, the majority of respondents were female (44.0%), were older (31.4% over age 45), were married (44.2%), and were working (31.2%). Nearly half (46%) had not attained a high school degree, rural respondents (42.3%) represented more than double the number of urban respondents (20.8%), and mean per capita annual household income was 9,800 RMBs. The overwhelming majority reported having health insurance (88.9%), while almost a quarter of respondents reported being a current smoker (23.6%).

Tables 2 and 3 show the descriptive statistics for the key independent and dependent variables of interest, respectively. Current drinkers accounted for 31.9% of the study population. Among these current drinkers, the majority reported frequent drinking (63.7%) and mean weekly consumption was 9.3 standard drinks. Heavy drinkers accounted for nearly one-fifth of current

drinkers (18.7%). A total of 121 (1.16%) respondents reported seeking formal medical care in the past four weeks, 480 (4.03%) respondents reported receiving preventive health services in the past four weeks, and 502 (4.22%) respondents reported visiting a folk doctor in the past year.

Results from the three sets of regression models are presented in Tables 4 through 6. Table 4 shows the odds ratios for the nine logistic regressions that include amount of alcohol consumed weekly as the key independent variable and the three healthcare utilization dependent variables: formal medical care, preventive healthcare services, and folk doctor visits. For Model 1, the unadjusted analyses with each alcohol consumption variable as a predictor with no other covariates, amount of alcohol consumed weekly was not significantly associated with formal medical care use [OR=0.99 (95% CI: 0.95-1.03)], preventive healthcare service use [OR=1.00 (95% CI: 0.98-1.02)], or folk doctor visits [OR=1.01 (95% CI:0.98-1.03)]. For Model 2, the analyses adjusted for all socio-demographic and other covariates, there also were no significant findings of association between amount of alcohol consumed weekly and formal medical care use [OR=1.00 (95% CI: 0.96-1.03)], preventive healthcare service use [OR=1.01 (95% CI: 0.99-1.03)], or folk doctor visits [OR=1.01 (95% CI: 0.98-1.04)]. As in the previous models, Model 3, which included all covariates except for current smoking status, did not detect significant associations between amount of alcohol consumed weekly and formal medical care use [OR=1.00 (95% CI: 0.96-1.03)], preventive healthcare service use [OR=1.01 (95% CI: 0.99-1.03)], or folk doctor visits [OR=1.01 (95% CI: 0.99-1.04)]. However, significant associations were found between healthcare utilization and other covariates. Rural residents compared to urban residents were significantly less likely to receive preventive healthcare services in both Model 2 [OR=0.30 (95% CI: 0.15-0.60)] and Model 3 [OR=0.30 (95% CI: 0.15-0.60)]. Additionally, high school and technical vocation school graduates [Model 2: OR=0.29 (95% CI: 0.08-0.98), and persons with a college degree or higher level of education [Model 2: OR=0.04 (95% CI: 0.00-0.97); Model 3: OR=0.04 (95% CI: 0.00-0.94)] all were significantly less likely to have visited a folk doctor in the past year compared to persons who did not graduate from primary school.

Table 5 shows the results for analyses examining the association between frequent drinking and the three healthcare utilization dependent variables. For Model 1, the unadjusted analysis, frequent drinkers were significantly less likely to have sought formal medical care [OR=0.45 (95% CI: 0.23-0.91)] and to have received preventive healthcare services [OR=0.54 (95% CI: 0.36-0.84)] compared to infrequent drinkers. The effect of frequent drinking on seeking formal medical care [Model 2: OR=0.67 (95% CI: 0.27-1.64); Model 3: OR=0.67 (95% CI: 0.27-1.65)] and receipt of preventive healthcare services [Model 2: OR=0.64 (95% CI: 0.40-1.03); Model 3: OR=0.63 (95% CI: 0.39-1.00)] became insignificant in Model 2 and Model 3, though, by excluding the current smoking status covariate in Model 3, the association between frequent drinking and preventive healthcare service approached significance (DIGITS TO 3 AND APA RECS). Frequent drinking did not have a significant effect on folk doctor visits for all three models [Model 1: OR=1.09 (95% CI: 0.62-1.92); Model 2: OR=0.80 (95% CI: 0.41-1.57); Model 3: OR=0.84 (95% CI: 0.43-1.65)]. For other covariates included in Models 2 and 3, similar to findings from the previous sets of analyses, rural residents were less likely to receive preventive healthcare services compared to urban residents [Model 2: OR=0.29 (95% CI: 0.15-0.54); Model 3: OR=0.29 (95% CI: 0.15-0.54)], and higher education levels, i.e., high school and vocational/technical school graduates [Model 2: OR=0.25 (95% CI: 0.08-0.79); Model 3: OR=0.25 (95% CI: 0.08-0.80)] and those with college degrees or higher [Model 2: OR=0.03 (95% CI: 0.00-0.53); Model 3: OR=0.03 (95% CI: 0.00-0.51)], were significantly associated

with less folk doctor use. Additionally, having health insurance was associated with increased likelihood to use preventive healthcare services [Model 2: OR=2.80 (95% CI: 1.04-7.55); Model 3: OR=2.82 (95% CI: 1.04-7.62)].

Table 6 shows the results for analyses examining the association between heavy drinking and the three healthcare utilization dependent variables. Similar to analyses including amount of alcohol consumed weekly as the alcohol consumption variable of interest, there were no significant effect of frequent drinking on healthcare utilization for all models. Specifically, heavy drinking was not significantly associated with formal medical care use [Model 1: OR=0.43 (95% CI: 0.13-1.43); Model 2: OR=0.46 (95% CI: 0.10-2.02); Model 3: OR=0.47 (95% CI: 0.11-2.04)], preventive healthcare service use [Model 1: OR=0.88 (95% CI: 0.48-1.60); Model 2: OR=1.00 (95% CI: 0.54-1.86); Model 3: OR=0.99 (95% CI: 0.54-1.84)], or folk doctor visits [Model 1: OR=1.67 (95% CI: 0.83-3.39); Model 2: OR=1.98 (95% CI: 0.90-4.35); Model 3: OR=2.10 (95% CI: 0.94-1.67)], regardless of adding all covariates to the model or excluding the current smoking status covariate. For other covariates, urban/rural location was significantly associated with receiving preventive healthcare services; rural residents compared to urban residents were significantly less likely to receive preventive healthcare services in both Model 2 [OR=0.31 (95% CI: 0.16-0.61)] and Model 3 [OR=0.31 (95% CI: 0.16-0.61)]. Again, high school and vocational/technical school graduates [Model 2: OR=0.29 (95% CI: 0.09-0.99)] and persons with college degrees or higher were significantly less likely to have visited a folk doctor compared to persons who did not graduate from primary school [Model 2: OR=0.04 (95% CI: 0.00-0.96); Model 3: OR=0.04 (95% CI: 0.00-0.93)].

## Discussion

In summary, the findings from the present study among adults in China are consistent with previous research examining the association between alcohol consumption and healthcare utilization conducted in Western countries. In the unadjusted models, frequent drinkers had significantly lower likelihood of seeking formal medical care and receiving preventive health services compared to infrequent drinkers, while there was no significant association detected between healthcare utilization and heavy drinking or weekly alcohol consumption. In the fully adjusted model, alcohol consumption behaviors (weekly alcohol consumption, frequent drinking and heavy drinking) had no significant effect on all three measures of healthcare utilization (seeking formal medical care, receipt of preventive healthcare services, and folk doctor visits).

These findings suggest two possible interpretations. The first is that frequent drinkers are healthier, thus requiring less health service use, and that heavy drinkers and amount of alcohol consumed weekly has no effect on healthcare utilization because there are no differences in healthcare needs between those who drink heavily and those who are moderate or light drinkers. The second is that these findings indicate underutilization of healthcare services among frequent drinkers and heavy drinkers. Given the very mixed evidence regarding the health effects of frequent drinking, which of these two interpretations is true for frequent drinking is difficult to determine at this time and requires future research on the health effects of frequent drinking among the Chinese population, including examination of the epidemiology of genetic variants that may contribute to protective health effects. Moreover, additional research regarding alcohol use trajectories is needed to ascertain the proportion of Chinese frequent drinkers who become problem drinkers. However, the overwhelming evidence that heavy drinking is associated with

higher risk for developing chronic diseases and having poor health suggests that, at least for heavy drinking, the latter interpretation seems more likely.

There are a number of theories for under-utilization of health services among problematic drinkers identified in Western research. The first is that problem drinkers may be characterized by bodily self-neglect and ignore health problems or symptoms of disease until these become well advanced and more costly to treat (Baumeister et al., 2006b; Jenkins & Zucker, 2010). A second possibility is that problem drinkers avoid preventive and other healthcare services due to embarrassment, shame, or fear regarding problematic drinking and its consequences (Green et al., 2010). However, problem drinkers may be unaware of their health status or the risks of hazardous drinking, a likely possibility in China due to the historical and cultural context of alcohol consumption. Indeed, a recent study using the 2006 wave of the CHNS data found that a one milliliter increase in daily intake of pure alcohol decreases a person's life span by 13 days, but increases the probability of self-reporting a good or excellent health, suggesting that drinkers are overconfident in their health status (Wang, Gao, & Wei, 2014). Traditionally, alcohol has played a central role in Chinese culture and has been consumed as part of celebrations, hospitality, medicinal practices, and religious rituals, contributing to the social acceptability of drinking, particularly among some segments of Chinese society, such as adult men (Cochrane et al., 2003; Hao et al., 2005). However, Chinese social norms, such as those that encourage social drinking but discourage solitary drinking, have tempered the volume of alcohol consumption in the past, and problematic alcohol consumption has only recently emerged as an issue in China alongside increasing Westernization and modernization (Cochrane et al., 2003; Hao et al., 1999; Hao et al., 2004; Hao et al., 2005; Zhang, Wang, Lu, Qiu, & Fang, 2004). Consequently, Chinese individuals may not be familiar with or have information regarding the problems associated with hazardous patterns of drinking.

The under-utilization of preventive healthcare services that can screen and provide early detection of chronic diseases associated with problematic alcohol use, such as cancer, diabetes mellitus, cardiovascular disease, and coronary heart disease, is particularly concerning for problem drinking group since diseases may be only detected at more advanced, and costly, stages. Health policy initiatives informing the Chinese public of the health risks of excessive alcohol consumption and the importance of preventive healthcare service use among drinkers can help reduce at-risk and other problematic patterns of drinking, as well as encourage increased utilization of cost-saving, and life-saving, healthcare services. However, further research is needed to understand the underlying causes of under-utilization of preventive health services among this group in China in order to develop effective interventions - for example, whether under-utilization is due to fear and shame or due to lack of knowledge will have different practice and policy implications.

However, it must be noted that descriptive statistics show extremely low levels of utilization of healthcare services overall, with a little over one percent of respondent reporting seeking formal medical care in the past four weeks, and about four percent each reporting receiving preventive healthcare services or visiting a folk doctor. There are several possible explanations for these findings. The first is that, in the CHNS survey, both survey items regarding formal medical care and preventive healthcare service had a very short time window of four weeks, which likely contributes to underestimation of healthcare utilization in this study. Indeed, compared to other studies examining healthcare utilization rates in China, these utilization rates are remarkably low. For example, based on data from the Chinese National Health Services Survey (NHHS), Zhou and colleagues (2013) estimated that the probability of an

outpatient medical visit to be 8.46% and the probability of an inpatient visit to be 6.16% in rural China in 2008. Nevertheless, even these higher estimates of healthcare utilization rates in China are low in comparison to Western countries; specifically, the United States Census data indicate that 84.6% of people visited a health care professional in 2009 (U.S. Census Bureau, 2012).

The apparent general underutilization of healthcare services in China can be attributed to the structure and development of the Chinese healthcare system, which represents an important component of Andersen's expanded model. Prior to the economic reforms of the late 1970s and 1980s, the Chinese healthcare system was organized on a three-tier system catering to its primarily rural population (Eggleston, 2012; Wang, Wilkinson, Ng, & Cheng, 2012). At the first level/contact of healthcare, paramedics with limited medical training, known famously as "barefoot doctors," provided basic medical services and health promotion activities, such as immunizations. These activities were financed under cooperative medical schemes managed by rural communes (Bardhan, 2008; Eggleston, 2012). Persons with medical problems that exceeded the skill level of these minimally trained "barefoot doctors" were referred to district hospitals, and those that exhibited the most complex problems were then managed at large municipal or regional centers (Wang et al., 2012). For the small but growing urban population, work-unit-based health insurance was provided by the government (Eggleston, 2012). While the medical sophistication of the estimated 1.8 million "barefoot doctors" was low, the widespread availability and use of medical care, alongside the Chinese government's vigorous policy for preventive care and against public health threats, contributed to an impressively high level of public health (Bardhan, 2008; Eggleston, 2012; Hvistendahl, 2013).

Following the market reforms and decollectivization in 1978, the rural health and "barefoot doctor" system collapsed as the Chinese government shifted funding "from rural to urban facilities and from community health service to specialized hospital care, with a mandate for health institutions to generate a large portion of their operating revenue" (Bhattacharyya, Delu, Wong, & Bowen, 2011, p.175). By the mid-1980s, the cooperative medical schemes covered less than 10% of the rural population and by the 1990s, the government was contributing less than 20% of total healthcare costs (Bardhan, 2008; Hvistendahl, 2013). Rural "barefoot doctors" became fee-for-service private providers, most likely comprising the folk doctors included in the present study, and while these types of medical providers typically are less costly, their minimal level of training likely contributes to low utilization except among those who cannot afford costlier types of care. Though urban areas were less impacted than rural ones, urban employees also saw increases in premiums and implementation of user fees (Bardhan, 2008; Eggleston, 2012). As the Chinese healthcare system evolved during this time to a largely privatized, or privately financed, system, several problems emerged. With a market system that resulted in the development of large and well-equipped hospitals, and the freedom among the public to choose medical care, the majority of patients opted to see hospital specialists, leading to the gradual demise of primary and general physician care and the current system of largely hospital-based delivery for both outpatient and inpatient care (Eggleston, 2012; Wang et al., 2012). Moreover, this privatized healthcare system and necessity to recoup from reduced government funds led to perverse financial incentives among providers, namely the tendency for over-medication, prescription of unnecessary high-technology diagnostic tests, and excessive hospitalization (Bardhan, 2008; Hvistendahl, 2013; Wang et al., 2012). Combined with patients' own preferences for unnecessary antibiotics and steroids, healthcare costs and "out-of-pocket" spending (i.e., direct payment by the patients and their families) increased dramatically (Bardhan, 2008; Eggleston, 2012).



These changes in the Chinese healthcare system and financing contributed to a lack of affordability and consequently, underutilization of healthcare services, particularly among the poor (Bardhan, 2008). For example, Liu and colleagues (2007) found that about half of respondents from the 2003 NHHS did not see a physician when they were ill. In the late 1980s and 2000s, the Chinese government endeavored to ameliorate these healthcare service challenges by implementing a number of voluntary government-subsidized and low-premium insurance schemes: (1) the 1998 Urban Employees' Basic Medical Insurance (UEBMI) system that replaced work-unit-based coverage for urban employees; (2) the 2002 initiation of the New Cooperative Medical Scheme (NCMS) that provided the rural population for non-catastrophic care; and the 2007 Urban Residents' Basic Medical Insurance (URBMI) system to cover medical expenses for urban resident not enrolled in the employee insurance program, such as students, retirees, and other dependents (Eggleston, 2012). Yet, these insurance schemes have been characterized as "wide, but shallow" coverage that have little impact on healthcare utilization, except perhaps for preventive healthcare, as evidenced by this study's findings that 88.9% of respondents had health insurance, yet only one analysis yielded a significant positive association between receipt of preventive healthcare and medical insurance (Yip et al., 2009).

Other significant reforms included the development and expansion of community health facilities in urban areas and township hospitals in rural areas, intended to be the cornerstone of the entire Chinese healthcare system as the first-level of contact for medical and preventive healthcare, as well as health education (Eggleston, 2012). However, capacity of these facilities are woefully low, with only one quarter of physicians and 2% of nurses staffing these facilities having a bachelor's level training (Bhattacharyya et al., 2011). As Andersen's expanded model notes, characteristics of the healthcare system, such as labor and capital resources, have an important impact on healthcare utilization. Another issue contributing to underutilization of these facilities is that a large percentage of them are not recognized by social health insurance, thus people would not be reimbursed if they sought care at these facilities, limiting financial access; in a survey conducted among 112 Chinese communities, only 28% reported that community health services were affordable (Bhattacharyya et al., 2011). These centers are also in competition with higher-level hospitals to attract patients, partially due to the current system of finance, where higher-level hospitals need high patient volume to cover their operating expenses (Bhattacharyya et al., 2011). Finally, there is an overall lack of knowledge, satisfaction, and confidence in these services; in the same survey mentioned above, 41% of respondent were not aware of the presence of these facilities in their community and only 35% of respondent reported that these facilities were safe (Bhattacharyya et al., 2011).

More recently, the Chinese government announced in 2009 a program of major healthcare reform in order to increase accessibility and affordability of healthcare, including formal support for the availability of primary care/general physician as the first level of healthcare contact, though the effect of these policies cannot be ascertained in this study since data are from 2009 (Eggleston, 2012). Thus, the problems prior to the 2009 of lack of training and low capacity among primary care physicians, lack or recognition of social health insurance, variation in reimbursement, low coordination with hospitals, and low satisfaction, confidence, and knowledge of healthcare services likely contribute to the low healthcare utilization rates for formal medical care and preventive care found in this study. Emerging research indicates that the 2009 reforms are having some positive impact on the utilization of healthcare services (Meng et al., 2012), and analyses of the 2011 CHNS survey will be conducted once data become available.

Additionally, definitions and cultural context of healthcare and medicine in China vastly differ from those that exist in Western countries. Thus, some of the inconclusive findings of this study could be due to these difference; for instance, one study describing the Chinese healthcare system cites *qigong*, a traditional Chinese martial arts and meditation practice, and dance groups as examples of preventive medicine, a stark contrast to the CHNS definition as diabetes screening, blood pressure monitoring, and other more biomedical characterizations of preventive healthcare (Gu, 1999). These types of non-biomedical practices are considered health promoting and preventive healthcare activities in the Chinese context, and should be included in future studies examining participation and utilization of preventive healthcare services.

Another characteristic associated with low levels of seeking preventive care is rural location. Across all three models, individuals residing in rural areas, after adjusting for health insurance status and income level, were less likely than their urban counterparts to receive preventive healthcare services. These findings indicate that individuals residing in rural areas are low utilizers of preventive healthcare services; future research should identify whether these low utilization rates persist after the 2009 reforms. If so, preventive healthcare promotion and building capacity for access to healthcare utilization in rural areas should be a policy priority in China.

This study has several limitations. The formal medical care measure included in this study included both inpatient and outpatient services because low rates of healthcare utilization among this population prohibited separation of these types of formal medical services in statistical analyses. Notably, research in Western countries has shown that the relationship between alcohol consumption and healthcare utilization varies by the type of healthcare service. Studies specifically investigating the use of acute and emergency medical services, such as ambulance calls and services, emergency room visits, and hospitalization, among drinkers are inconsistent; some studies show increased utilization (see Balsa, French, Maclean, & Norton, 2009; Bertakis & Azari, 2006; Vals, Kiivet, & Leinsalu, 2013), while others found no effect or decreased utilization (see Li & Jensen, 2012; Ogborne & DeWit, 2001; Polen et al., 2001; Rodriguez-Artalejo et al., 2000). Yet, studies looking at outpatient services, such as physician visits, have overwhelmingly demonstrated a negative association (Baumeister et al., 2006a; Baumeister et al., 2006b; Ford et al., 2005; Heise, 2010; Jenkins & Zucker, 2010; Ogborne & DeWit, 2001; Polen et al., 2001; Rice et al., 2000; Yan et al., 2014; Zarkin et al., 2004). Future research should examine the relationships between alcohol consumption and utilization of these two types of healthcare service, inpatient and outpatient care, separately to determine if similar differences exist in China.

Another limitation is that this study included only three measures of alcohol consumption (amount of alcohol consumed weekly, frequent drinking, and heavy drinking). While these measures permit, to some extent, the examination of different aspects of alcohol consumption, this study could not examine the association of healthcare services utilization with specific patterns of problematic alcohol consumption. Statistical analysis examining patterns of drinking (combined frequency and amount) could not be performed due to very small numbers of people reporting heavy infrequent drinking and current lack of appropriate regression techniques for multi-level analyses of categorical outcomes. Additionally, the most refined alcohol consumption quantity measure asked only about quantity of alcohol consumed per week, not per drinking episode, which precludes the ability to analyze factors associated with binge drinking, defined as five or more alcoholic beverages consumed by men and four or more alcoholic beverages consumed by women per two-hour drinking episode (NIAAA, 2004). As Rehm

(1998) notes, frequency only measures cannot differentiate between light, moderate, and heavy drinkers per drinking occasion nor identify variability in drinking patterns, both of which influence immediate and chronic outcomes. Future research should investigate the direct association of healthcare services utilization with problematic drinking patterns, such as heavy frequent drinking and binge drinking, and with differences among lifetime abstainers and former drinkers. A final limitation is wide confidence intervals for some of covariates, which is likely due to high variability and low rates of healthcare service utilization. Future research should oversample for healthcare users to confirm findings from this study.

Despite these limitations, this study is the first to examine the association between healthcare service utilization and alcohol consumption in China. This study provides initial evidence of potential underutilization of health services among problematic drinkers. Despite the vast organizational and structural differences between the Chinese healthcare system and Western healthcare systems, the association between healthcare utilization and alcohol consumption appears similar. Promotion of health service use, especially preventive care, among Chinese drinkers at risk for the development of costly chronic diseases is recommended.

Table 1. Socio-demographic characteristics of the study population

	% of Total N <sup>1</sup>
	(N=18,917)
Gender	
Male	41.8
Female	44.0
Age, year	
18-25 y	3.8
26-35 y	6.3
36-45 y	11.7
46-55 y	12.1
56+ y	19.2
Marital status	
Never married	3.6
Married	44.2
Divorced/Separated/ Widowed	5.2
Employment status	
Working	31.2
Seeking work, Student, Housework	10.4
Retired, Disabled, Other	11.4
Education level	
<Primary school	14.7
<High school	31.3
High school/ Technical & Vocational school	10.7
College degree or higher	2.9
Mean per capita household income (in 1000 RMBs) <sup>2</sup>	9.8
Urban/Rural	
Urban	20.8
Rural	42.3
Has health insurance	88.9
Current smoker	23.6

1. Percentages in categories may not sum to 100% due to missing values

2. Mean

Table 2. Frequencies/percentages of key independent variables (Alcohol consumption measures)

Current Drinkers <sup>1</sup> (%)	Mean Weekly Consumption <sup>2</sup> (Standard Drinks)	% Frequent Drinkers <sup>3</sup> (%)	% Heavy Drinkers <sup>3</sup> (%)
31.9 (n=3391)	9.3 (n=3077)	63.7 (n=2121)	18.7 (n=633)

1. % among total valid respondents
2. Mean for current drinkers
3. % among current drinkers

Table 3. Frequencies/percentages of dependent variables (Healthcare utilization variables)

Used formal medical care in past four weeks %	Used preventive healthcare services in past four weeks %	Visited a folk doctor in the past year %
1.16 (n=121)	4.03 (n=480)	4.22 (n=502)

Table 4. Logistic regression analysis of the association between healthcare utilization and alcohol consumed weekly and socio-demographic variables

	Sought formal medical care in past 4 weeks			Received preventive health services in past 4 weeks			Visited a folk doctor In past year		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
<b>Weekly alcohol consumption</b>	0.99 (0.95 -1.03)	1.00 (0.96-1.03)	1.00 (0.96-1.03)	0.99 (0.95 -1.03)	1.00 (0.96-1.03)	1.00 (0.96-1.03)	0.99 (0.95 -1.03)	1.00 (0.96-1.03)	1.00 (0.96-1.03)
Gender									
Male <sup>1</sup>		--	--		--	--		--	--
Female		3.63 (0.95-13.91)	<b>3.42*</b> <b>(1.02-11.50)</b>		3.63 (0.95-13.91)	<b>3.42*</b> <b>(1.02-11.50)</b>		3.63 (0.95-13.91)	<b>3.42*</b> <b>(1.02-11.50)</b>
Age, year									
18-25 y <sup>1</sup>		--	--		--	--		--	--
26-35 y		1.60 (0.04-67.20)	1.60 (0.04-67.90)		1.60 (0.04-67.20)	1.60 (0.04-67.90)		1.60 (0.04-67.20)	1.60 (0.04-67.90)
36-45 y		2.65 (0.06-115.52)	2.65 (0.06-116.71)		2.65 (0.06-115.52)	2.65 (0.06-116.71)		2.65 (0.06-115.52)	2.65 (0.06-116.71)
46-55 y		0.96 (0.02-43.28)	0.96 (0.02-43.56)		0.96 (0.02-43.28)	0.96 (0.02-43.56)		0.96 (0.02-43.28)	0.96 (0.02-43.56)
56+ y		4.25 (0.09-209.41)	4.24 (0.09-211.19)		4.25 (0.09-209.41)	4.24 (0.09-211.19)		4.25 (0.09-209.41)	4.24 (0.09-211.19)
Marital status									
Never married <sup>1</sup>		--	--		--	--		--	--
Married		1.50 (0.04-59.68)	1.52 (1.04-61.01)		1.50 (0.04-59.68)	1.52 (1.04-61.01)		1.50 (0.04-59.68)	1.52 (1.04-61.01)
Divorced/Separated/ Widowed		0.67 (0.01-58.28)	0.68 (0.01-58.83)		0.67 (0.01-58.28)	0.68 (0.01-58.83)		0.67 (0.01-58.28)	0.68 (0.01-58.83)
Employment status									
Working <sup>1</sup>		--	--		--	--		--	--
Seeking work, Student, Housework		1.56 (0.28-8.72)	1.57 (0.28-8.76)		1.56 (0.28-8.72)	1.57 (0.28-8.76)		1.56 (0.28-8.72)	1.57 (0.28-8.76)
Retired, Disabled, Other		0.88 (0.24-3.23)	0.86 (0.24-3.12)		0.88 (0.24-3.23)	0.86 (0.24-3.12)		0.88 (0.24-3.23)	0.86 (0.24-3.12)

	Sought formal medical care in past 4 weeks			Received preventive health services in past 4 weeks			Visited a folk doctor In past year		
	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 3 OR (95%CI)	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 3 OR (95%CI)	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 3 OR (95%CI)
Education level									
<Primary school <sup>1</sup>		--	--		--	--		--	--
<High school		8.39 (0.45-157.60)	8.28 (0.44-155.41)		0.82 (0.37-1.83)	0.83 (0.37-1.85)		0.48 (0.18-1.26)	0.48 (0.18-1.27)
High school/Tech.& Voc. school		4.94 (0.25-98.75)	4.92 (0.25-98.62)		1.35 (0.55-3.33)	1.36 (0.55-3.37)		<b>0.29*</b> <b>(0.08-0.98)</b>	0.29 (0.08-1.00)
College degree or higher		15.56 (0.52-464.03)	15.23 (0.51-451.75)		1.13 (0.35-3.63)	1.18 (0.37-3.74)		<b>0.04*</b> <b>(0.00-0.97)</b>	<b>0.04*</b> <b>(0.00-0.94)</b>
Mean household income (in 1000 RMBs)		1.16 (0.73-1.84)	1.16 (0.73-1.84)		1.21 (0.90-1.61)	1.21 (0.91-1.62)		0.84 (0.60-1.19)	0.83 (0.58-1.17)
Urban/Rural									
Urban <sup>1</sup>		--			--	--		--	--
Rural		1.33 (0.44-4.02)	1.33 (0.44-4.01)		<b>0.30**</b> <b>(0.15-0.60)</b>	<b>0.30***</b> <b>(0.15-0.60)</b>		1.23 (0.42-3.59)	1.26 (0.42-3.73)
Sick/injured in past 4 weeks		<b>50.21***</b> <b>(7.80-323.04)</b>	<b>50.13***</b> <b>(7.69-326.83)</b>		--	--		--	--
Has health insurance		0.50 (0.11-2.36)	0.51 (0.11-2.37)		2.51 (0.87-7.24)	2.54 (0.88-7.37)		0.79 (0.23-2.70)	0.76 (0.22-2.63)
Current smoker		1.12 (0.38-3.28)	--		0.82 (0.48-1.39)	--		1.80 (0.83-3.91)	--

Note: Asterisks indicate \*\*\* $P < 0.001$ , \*\* $P < 0.01$ , \* $P < 0.05$ ; 1. Reference group

Table 5. Logistic regression analysis of the association between healthcare utilization and frequent drinking and socio-demographic variables

	Sought formal medical care in past 4 weeks			Received preventive health services in past 4 weeks			Visited a folk doctor In past year		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
<b>Frequent drinker</b>	<b>0.45*</b> <b>(0.23-0.91)</b>	0.67 (0.27-1.64)	0.67 (0.27-1.65)	<b>0.54**</b> <b>(0.36-0.84)</b>	0.64 (0.40-1.03)	0.63 (0.39-1.00)	1.09 (0.62-1.92)	0.80 (0.41-1.57)	0.84 (0.43-1.65)
Gender									
Male <sup>1</sup>		--	--		--	--		--	--
Female		<b>4.05*</b> <b>(1.22-13.48)</b>	<b>3.67*</b> <b>(1.28-10.54)</b>		1.25 (0.68-2.33)	1.34 (0.76-2.39)		2.09 (0.78-5.62)	1.60 (0.64-3.97)
Age, year									
18-25 y <sup>1</sup>		--	--		--	--		--	--
26-35 y		1.50 (0.05-47.36)	1.50 (0.05-47.16)		1.45 (0.39-5.38)	1.45 (0.39-5.40)		1.04 (0.14-7.95)	1.02 (0.13-7.83)
36-45 y		2.75 (0.09-86.87)	2.74 (0.09-86.73)		1.75 (0.45-6.84)	1.74 (0.45-6.81)		2.22 (0.30-16.67)	2.17 (0.29-16.41)
46-55 y		1.49 (0.05-48.96)	1.48 (0.05-48.51)		1.34 (0.34-5.28)	1.33 (0.34-5.24)		0.92 (0.13-6.70)	0.90 (0.12-6.54)
56+ y		4.51 (0.14-150.54)	4.45 (0.13-148.77)		2.67 (0.64-11.16)	2.68 (0.64-11.22)		2.30 (0.29-18.29)	2.20 (0.28-17.54)
Marital status									
Never married <sup>1</sup>		--	--		--	--		--	--
Married		1.46 (0.05-42.95)	1.49 (0.5-43.85)		0.61 (0.19-2.01)	0.61 (0.18-2.01)		2.97 (0.40-22.19)	2.91 (0.39-21.80)
Divorced/Separated/ Widowed		0.61 (0.01-35.32)	0.61 (0.01-35.30)		0.32 (0.06-1.60)	0.32 (0.06-1.59)		4.07 (0.43-38.63)	4.02 (0.42-38.37)
Employment status									
Working <sup>1</sup>		--	--		--	--		--	--
Seeking work, Student, Housework		1.02 (0.20-5.07)	1.03 (0.21-5.12)		1.12 (0.52-2.41)	1.12 (0.52-2.40)		0.35 (0.10-1.18)	0.35 (0.10-1.19)
Retired, Disabled, Other		0.86 (0.28-2.68)	0.83 (0.27-2.56)		0.61 (0.30-1.21)	0.61 (0.31-1.22)		0.47 (0.18-1.23)	0.45 (0.17-1.28)
Education level									
<Primary school <sup>1</sup>		--	--		--	--		--	--
<High school		7.52 (0.74-76.34)	7.36 (0.73-74.23)		0.83 (0.40-1.71)	0.83 (0.40-1.72)		0.46 (0.19-1.12)	0.46 (0.19-1.19)
High school/Tech.& Voc. school		4.11 (0.33-50.94)	4.07 (0.33-50.16)		1.27 (0.56-2.89)	1.28 (0.56-2.91)		<b>0.25*</b> <b>(0.08-0.79)</b>	<b>0.25*</b> <b>(0.08-0.80)</b>
College degree or higher		9.98 (0.67-151.72)	9.59 (0.64-143.82)		0.93 (0.32-2.69)	0.96 (0.33-2.75)		<b>0.03*</b> <b>(0.00-0.53)</b>	<b>0.03**</b> <b>(0.00-0.51)</b>



	Sought formal medical care in past 4 weeks			Received preventive health services in past 4 weeks			Visited a folk doctor In past year		
	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 3 OR (95%CI)	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 3 OR (95%CI)	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 3 OR (95%CI)
Mean household income (in 1000 RMBs)		1.13 (0.75-1.72)	1.13 (0.75-1.71)		1.23 (0.94-1.60)	1.23 (0.95-1.60)		0.93 (0.67-1.27)	0.91 (0.66-1.26)
Urban/Rural									
Urban <sup>1</sup>		--			--	--		--	--
Rural		1.19 (0.44-3.18)	1.18 (0.44-3.15)		<b>0.29***</b> <b>(0.15-0.54)</b>	<b>0.29***</b> <b>(0.15-0.54)</b>		1.08 (0.38-3.05)	1.10 (0.39-3.13)
Sick/injured in past 4 weeks		<b>47.58***</b> <b>(17.37-130.37)</b>	<b>47.22***</b> <b>(17.29-128.93)</b>		--	--		--	--
Has health insurance		0.38 (0.10-1.42)	0.38 (0.10-1.42)		<b>2.80*</b> <b>(1.04-7.55)</b>	<b>2.82**</b> <b>(1.04-7.62)</b>		1.04 (0.32-3.41)	1.01 (0.31-3.32)
Current smoker		1.19 (0.44-3.20)	--		0.86 (0.53-1.40)	--		1.67 (0.83-3.36)	--

Note: Asterisks indicate \*\*\* $P < 0.001$ , \*\* $P < 0.01$ , \* $P < 0.05$ ; 1. Reference group

Table 6. Logistic regression analysis of the association between healthcare utilization and heavy drinking and socio-demographic variables

	Sought formal medical care in past 4 weeks			Received preventive health services in past 4 weeks			Visited a folk doctor In past year		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
<b>Heavy drinker</b>	0.43 (0.13-1.43)	0.46 (0.10-2.02)	0.47 (0.11-2.04)	0.88 (0.48-1.60)	1.00 (0.54-1.86)	0.99 (0.54-1.84)	1.67 (0.83-3.39)	1.98 (0.90-4.35)	2.10 (0.94-1.67)
Gender									
Male <sup>1</sup>		--	--		--	--		--	--
Female		3.51 (0.91-13.55)	3.25 (0.96-10.96)		1.43 (0.72-2.83)	1.56 (0.83-2.93)		2.30 (0.78-6.80)	1.73 (0.63-4.71)
Age, year									
18-25 y <sup>1</sup>		--	--		--	--		--	--
26-35 y		1.75 (0.04-78.63)	1.76 (0.04-80.48)		1.36 (0.32-5.70)	1.34 (0.32-5.60)		1.28 (0.10-16.21)	1.29 (0.10-16.71)
36-45 y		2.88 (0.06-134.00)	2.90 (0.06-137.42)		1.59 (0.36-6.98)	1.56 (0.36-6.79)		2.73 (0.23-32.14)	2.77 (0.23-33.35)
46-55 y		1.06 (0.02-51.23)	1.06 (0.02-52.29)		1.22 (0.28-5.37)	1.18 (0.27-5.20)		1.01 (0.09-11.60)	1.00 (0.09-11.77)
56+ y		4.87 (0.09-256.80)	4.90 (0.09-262.72)		2.34 (0.50-11.02)	2.30 (0.49-10.77)		2.20 (0.18-27.24)	2.17 (0.17-27.48)
Marital status									
Never married <sup>1</sup>		--	--		--	--		--	--
Married		1.55 (0.04-66.24)	1.56 (0.04-68.29)		0.51 (0.14-1.87)	0.51 (0.14-1.87)		8.92 (0.47-170.57)	8.94 (0.45-178.24)
Divorced/Separated/ Widowed		0.68 (0.01-62.12)	0.69 (0.01-64.39)		0.22 (0.04-1.35)	0.22 (0.04-1.36)		14.10 (0.60-333.77)	14.38 (0.58-356.22)
Employment status									
Working <sup>1</sup>		--	--		--	--		--	--
Seeking work, Student, Housework		1.57 (0.27-8.99)	1.58 (0.28-9.07)		1.28 (0.56-2.93)	1.28 (0.56-2.94)		0.31 (0.07-1.27)	0.30 (0.07-1.29)
Retired, Disabled, Other		0.81 (0.21-3.05)	0.78 (0.21-2.90)		0.66 (0.31-1.39)	0.67 (0.32-1.41)		0.58 (0.21-1.60)	0.55 (0.20-1.55)
Education level									
<Primary school <sup>1</sup>		--	--		--	--		--	--
<High school		8.54 (0.48-153.10)	8.41 (0.47-150.15)		0.83 (0.37-1.85)	0.84 (0.38-1.86)		0.49 (0.19-1.27)	0.48 (0.18-1.28)
High school/Tech.& Voc. school		4.73 (0.24-92.62)	4.71 (0.24-92.15)		1.35 (0.55-3.33)	1.36 (0.56-3.35)		<b>0.29*</b> <b>(0.09-0.99)</b>	0.30 (0.09-1.02)
College degree or higher		15.51 (0.55-439.29)	15.07 (0.54-423.21)		1.15 (0.36-3.66)	1.19 (0.38-3.75)		<b>0.04*</b> <b>(0.00-0.96)</b>	<b>0.04*</b> <b>(0.00-0.93)</b>

	Sought formal medical care in past 4 weeks			Received preventive health services in past 4 weeks			Visited a folk doctor In past year		
	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 3 OR (95%CI)	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 3 OR (95%CI)	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 3 OR (95%CI)
Mean household income (in 1000 RMBs)		1.17 (0.74-1.86)	1.17 (0.74-1.86)		1.21 (0.91-1.61)	1.22 (0.91-1.62)		0.84 (0.60-1.18)	0.82 (0.58-1.17)
Urban/Rural									
Urban <sup>1</sup>		--			--	--		--	--
Rural		1.33 (0.44-4.05)	1.33 (0.44-4.05)		<b>0.31**</b> <b>(0.16-0.61)</b>	<b>0.31**</b> <b>(0.16-0.61)</b>		1.21 (0.42-3.55)	1.24 (0.42-3.69)
Sick/injured in past 4 weeks		<b>52.23***</b> <b>(8.82-309.26)</b>	<b>52.31***</b> <b>(8.73-313.51)</b>		--			--	--
Has health insurance		0.48 (0.10-2.28)	0.48 (0.10-2.30)		2.46 (0.86-7.03)	2.49 (0.88-7.14)		0.83 (0.24-2.79)	0.80 (0.23-2.73)
Current smoker		1.16 (0.40-3.38)	--		0.84 (0.50-1.42)	--		1.76 (0.82-3.77)	--

Note: Asterisks indicate \*\*\* $P < 0.001$ , \*\* $P < 0.01$ , \* $P < 0.05$ ; 1. Reference group

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## Dissertation Conclusion

The three papers presented above contribute to our understanding regarding alcohol consumption in China, as well as indicate directions for developing alcohol policy approaches and interventions that are applicable and appropriate to the Chinese context and conditions. Together, these papers show both similarities and differences between Western and Chinese alcohol consumption behaviors, and their correlates and association with healthcare service use. Consequently, while some alcohol policies and interventions that have demonstrated effectiveness in Western countries can potentially be successful in reducing problematic alcohol use and alcohol-related harms in China, others may less be impactful or relevant, at least with respect to the current Chinese alcohol consumption behaviors and patterns.

Both Papers 1 and 2 shows very different patterns of alcohol consumption among different socio-demographic groups in China, compared to those found in Western countries, particularly with respect to gender, age, and employment status. Though Chinese women continued to be significantly less likely than Chinese men to be current, frequent, and heavy drinkers, and drank significantly less than men, as continues to be the pattern found in Western countries, this study shows that problematic drinking among current women drinkers, particularly heavy drinking, is increasing. Moreover, urban women are more likely than their rural counterparts to be current drinkers, supporting earlier findings from a study conducted in Hunan (Zhou et al., 2006). Both urban women and men may be likely to be vulnerable for the development of alcohol-associated problems and are important groups for which to target prevention and intervention efforts. This study found significant association between current drinking and higher education levels among women in 2009, a pattern that has been documented in other countries, suggesting more highly educated Chinese women are less likely to be bound by traditional social norms (Ahlström, Bloomfield, & Knibbe, 2001; Bloomfield, Grittner, Kramer, & Gmel, 2006). However, study findings also show lower amounts of drinking among this group, indicating that, though more highly educated women are more likely to drink, they are also more likely to be moderate drinkers than less educated women. Women with lower levels of education may not be aware of the impact of excessive drinking, and information regarding problematic alcohol use should be made available to them in settings outside of formal education institutions. Continued longitudinal examination of alcohol consumption behaviors among women in China is recommended.

Paper 1 and 2 also show that older and middle-aged Chinese adults are more likely to drink alcohol, consume more alcohol, and be heavy and frequent drinkers than younger Chinese adults, whereas in the United States, though alcohol consumption is declining more slowly among recent cohorts compared to earlier cohorts, older adults tend to drink less than younger people (Caetano, Barauh, Ramisetty-Mikler, & Ebama, 2010; Moore et al., 2005). The findings from Papers 1 and 2 suggest a cohort effect in China, in which younger cohorts over time tend to consume less and drink less frequently than older cohorts. On the one hand, this rather surprising trend could indicate increasing awareness of problems associated with alcohol among younger people. Additionally, this may reflect changing drinking patterns in which younger cohorts are less likely to practice traditional frequent use of alcohol for medicinal purposes, particularly medicinal liquor which includes traditional herbs and has customarily been used as elixirs for the improvement of general health and the treatment of ailments, such as arthritis and impotence (Hao et al., 2005).

However, these findings may also indicate that problematic alcohol consumption peak in later life in China, whereas alcohol consumption typically peaks during young adulthood in Western countries (Johnstone, Leino, Ager, Ferrer, & Fillmore, 1996; Karlamangla, Zhou, Reuben, Greendale, & Moore, 2006; Kuntche, Rhm, & Gmel, 2004). Older Chinese adults may also not be aware of the combined effects of problematic and heavy alcohol consumption and aging, such as decreased brain function, increased risk for dementia, and increased risk of injury (Mukamal et al., 2003; Sorock, Chen, Gonzalzo, & Baker, 2006). Moreover, heavy, frequent, and other problematic drinking behaviors during middle age can contribute to health problems emerging in later life, such as cognitive impairment (Anttila et al., 2004; Goldberg, Burchfiel, Reed, Wergowske, & Chiu, 1994). Targeted public health campaigns may help educate older and middle-aged Chinese adults regarding the harms associated with excessive alcohol consumption, and screening for alcohol misuse among Chinese middle-aged and older adults may help identify individuals at risk for alcohol-related problems.

Another important policy implication from these findings is that minimum alcohol purchasing age, while a mainstay of alcohol control policy in most Western-countries, may be less relevant, at least in the current Chinese context. Although minimum age laws for alcohol purchase and consumption were nominally passed in 2006, enforcement of this policy is not currently financed. The present research suggests that younger persons do not currently demonstrate risk for problematic alcohol consumption, and that resources for policy and practice interventions would be better directed toward the middle- and older-aged Chinese individuals.

Paper 2 also shows mixed findings regarding the association between availability of alcohol and alcohol consumption in China. In particular, the findings of the increased likelihood of current drinking with location of alcohol vendors outside the neighborhood (compared to having alcohol vendors located within the neighborhood), as well as higher local liquor costs, are unexpected. These findings may indicate that the decision to currently drink is more complicated than merely including consideration of environmental availability (physical access) and cost.

Given the cultural context of drinking within China, particularly the ritualized practice of work-related alcohol consumption as a means to forge and maintain *guanxi*, or relationships, and bond with superiors and colleagues, it is possible that those who currently drink may do so within the vicinity of their places of employment rather than within their neighborhood (Cochrane et al., 2003; Hao et al., 2005; Zhou, Hu, Fan, & Fang, 2013). The finding that employment is significantly associated with higher likelihood of current drinking and increased levels of consumption in Paper 1 and 2 support this hypothesis. Several news articles have been published in recent years regarding the Chinese culture and practice of employment-related drinking, during which heavy and binge drinking and participating in toasts to *gan bei*, translated literally as “dry cup”, are seen as essential to building *guanxi* (Hong, 2009; Jie, 2009; Szeto, 2013). As the consequences of these problematic drinking behaviors and practices come to the forefront, the Chinese government has an opportunity to not only remove funding for government-related alcohol activities, but also to engage in public campaigns to shift social norms regarding alcohol consumption and promote awareness of the harms associated with hazardous alcohol consumption, particularly heavy and binge drinking, among the general population. The adoption of policies prohibiting work incentives and performance rewards on the basis of alcohol consumption can provide legal recourse for Chinese employees subject to these practices.

Additionally, Paper 2 showed that distance to stores selling alcoholic beverages and the number of bars located within the neighborhood were not associated with heavy and frequent drinking or amount of alcohol consumed weekly, but absence of alcohol vendors within the neighborhood was found to impact heavy and frequent drinking, and amount of alcohol consumed. This suggests that policies aimed at reducing density of alcohol vendors may not be effective if at least one alcohol vendor is already present within the neighborhood, given that proximity to alcohol vendors in the neighborhood and the number of bars within a neighborhood have no significant effect on alcohol consumption. However, policies concerning zoning of alcohol vendors, such as zoning alcohol vendors outside of residential neighborhoods, may be effective in reducing alcohol consumption and alcohol-related problems (Ashe, Jernigan, Kline, & Galaz, 2003).

Cost of local beer was found to have a significant impact on frequent drinking, heavy drinking and amount of alcohol consumed. That is, individuals consumed less alcohol and were less likely to be frequent drinkers the higher the cost of local beer. These findings suggest that cost of beer plays a significant factor in how much and how frequently a person drinks alcohol, contrary to findings from Western-based studies that have found beer to be less responsive to price compared to wine and spirits (Cook & Moore, 2002; Wagenaar, Salois, & Komro, 2009). Moreover, at least anecdotally, beer consumption is increasing in popularity and beer demand is growing in China (Jun, 2013). These findings regarding beer consumption suggest that policies aimed at increasing local beer price in China can contribute to lower and less frequent alcohol consumption, and likely, alcohol use disorders and other alcohol-related problems. Furthermore, studies examining the potential effect of taxation of cigarettes, another so-called “sin” commodity, indicate that taxation strategies can reduce consumption of these types of goods in the Chinese context (Bishop, Liu, & Meng, 2007; Chen & Xing, 2011).

In Paper 3, similar to findings in Western-based studies, alcohol consumption behaviors either had no significant effect or a negative effect on healthcare utilization in China. Current drinking, heavy drinking, and amount of alcohol consumed weekly had no significant effect on all three measures of healthcare utilization (seeking formal medical care, receipt of preventive healthcare services, and folk doctor visits). The only significant relationships found were negative associations between frequent drinking and seeking formal medical care, and between frequent drinking and preventive healthcare utilization. Given the very mixed evidence regarding the health effects of frequent drinking, it is difficult to ascertain whether frequent drinkers use less healthcare services because they are healthier or if they are underutilizing health care services. However, the overwhelming evidence that heavy drinking is associated with higher risk for developing chronic diseases and having poor health suggests that, at least for heavy drinking, findings that their utilization rates do not differ from light or moderate drinkers indicates underutilization among heavy drinkers. The underutilization of preventive healthcare services that can screen and provide early detection of chronic diseases associated with problematic alcohol use is particularly concerning for this at-risk drinking group since diseases may be only detected at more advanced, and costly, stages. Health policy initiatives informing the Chinese public of the health risks of excessive alcohol consumption and the importance of preventive healthcare service use among drinkers can help reduce at-risk and other problematic patterns of drinking, as well as encourage increased utilization of cost-saving, and life-saving, healthcare services. Furthermore, as the harms related to tobacco use have become a health issue priority for Chinese public health officials and practitioners, it is recommended that prevention,

education, and intervention efforts regarding alcohol use occur along with tobacco use, especially considering the high correlation between alcohol and tobacco consumption.

However, an important consideration is whether or not the Chinese government would be willing to adopt these policy recommendations. Tang and colleagues (2013) recommend the development of a comprehensive national alcohol policy framework and the adoption of variety of alcohol policies, as prescribed by WHO's *Global strategy to reduce the harmful use of alcohol*, including the following: strengthening taxation; legislation on drink driving, age restrictions and marketing controls, scaling up treatment programs, reducing drinking among government employees, increased research and surveillance, and social marketing to support policy and treatment. Of these, the present research provides evidence supporting the applicability of policies regarding taxation, drinking among government employees, and social marketing and health promotion/public awareness campaigns. However, as they note, "few things can be accomplished in China without the direct involvement and support of the central government", and thus far, "alcohol use has received scant attention from Chinese policy-makers and public health officials" (Tang et al., 2013, p. 274).

The likelihood of the Chinese government adopting any alcohol control is influenced by several factors, which can be informed by the comparative analysis framework developed by David Dolowitz's and David Marsh's (1996) concept of "policy transfer," which builds on other related work on comparative policy analysis, such as Richard Rose's (1991, 1993) concept of "lesson-drawing" and Colin Bennett's (1991) concept of "emulation" and "harmonization." Generally, "policy transfer" is defined as "a process in which knowledge about policies, administrative arrangements, institutions etc. in one time and/or place is used in the development of policies, administrative arrangements and institutions in another time and/or place" (Dolowitz & Marsh, 1996, p. 344). In the earlier work by Rose and Bennett, transfer is seen as a "voluntaristic activity", where the "decision-making elite in one country import innovative policy developed elsewhere in the belief that it will be similarly successful in a different context...[and] send fact-finding missions to monitor overseas developments and use the collected evidence to shape policies at home" (Stone, 1999, p. 52). Dolowitz and Marsh expand this concept to include "direct coercive transfer," where "one government forces another to adopt a policy", and "indirect coercive transfer", where the role of externalities, pushed forward by forces of globalization where global economic and to some extent political interdependence, lead to policy transfer (Dolowitz & Marsh, 1996, p. 347-348). Additionally, Dolowitz and Marsh (1996, p. 340) note that "a country can be indirectly pushed towards policy transfer if political actors perceive their country as falling behind its neighbors or competitors."

In the case of China, particularly with regards to drug and alcohol policy, there is evidence of all three types of modalities of policy transfer. For example, the Chinese government's endorsement and funding of illicit drug harm reduction policy, such as methadone maintenance programs for opiate addiction, can be seen as falling in the "voluntaristic" type of policy transfer, where empirical evidence of successful policy approaches to a social problem has been adopted. These policy developments can be seen as occurring outside of international pressure and constraints, especially given that the United States has until recently rejected harm reduction approaches. In a second example, the Chinese government signed the WHO Framework Convention on Tobacco Control (FCTC) in November 2003, and China's compliance with and implementation of FCTC represents "direct coercive transfer," where international governmental bodies place direct pressure on China's domestic approach to tobacco control policies (Wan et al., 2012). Finally, China's 2006 passing of a minimum age drinking

law appears may be seen as an example of “indirect coercive transfer,” for which pressure to adopt this type of alcohol control policy stems from China’s desire to conform with international standards and expectations, especially those put forth by the WHO global alcohol policy comparison reports and strategy to reduce the harmful use of alcohol. However, given that the minimum age drinking law has not been accompanied by resources or directives for enforcement, this policy transfer could be categorized as one that is incomplete and, in more severe consideration, one that is an empty gesture.

Thus, outside of external international pressure, prioritization of adoption, implementation, and enforcement of alcohol control policies requires recognition by the Chinese government regarding the growing problems associated with alcohol consumption in China and the current opportunity to apply a preventive public health approach that will result in long-term benefits both politically and economically (Tang et al., 2013). The findings regarding increases in harmful alcohol consumption among the Chinese population documented in this dissertation, as well as the increases in alcohol-related problems in the emerging research, can provide the evidence base and persuasion to the Chinese government regarding the necessity of alcohol control policies. Moreover, alcohol control policies and the development of a public health-oriented national strategic framework to address alcohol-related problems integrate well with the Chinese government’s current healthcare reforms emphasizing health promotion and focusing on prevention, for which community health workers can play an important role in health education (Li et al., 2014).

Another important consideration is the likelihood of effectiveness of specific alcohol control policies in China, particularly those indicated by the present research. However, assessment of the impact of policies that have not yet been implemented is difficult, beyond the evidence that factors, such as cost and location, do have an impact on alcohol consumption behaviors. Thus, information regarding the likelihood of the success of policies necessarily come from the research from other countries that are similar to China, or in other issues that are similar to alcohol in China. The few empirical studies that have examined the association of alcohol taxation with alcohol consumption behaviors in Asian countries have mixed findings. Several studies found that 2002 implementation of alcohol taxation was associated with decreased alcohol-attributed diseases and alcohol-attributable disease mortality in Taiwan (Lin, Liao, & Li, 2011; Lin & Liao, 2013; Lin & Wen, 2012), while Chung and colleagues (2013) found that decreased taxation was associated with increased alcohol consumption in Hong Kong. However, Chung and colleagues (2013) also found that the prevalence of binge drinking, alcohol abuse, and alcohol dependence decreased following the reduction of alcohol duties. Nevertheless, this limited body of research points to the likelihood of a positive impact of cost-modifying alcohol control policies on reducing alcohol related problems.

Across all three papers, policies promoting public education regarding the harms of excessive alcohol consumption are recommended. Though no such policy currently exists in China, the Chinese experience with mass media campaigns regarding tobacco use can be informative. Specifically, the 2009 “Giving Cigarettes is Giving Harm” (GCGH) campaign was launched to “raise awareness of tobacco-attributed disease and reduce the social acceptability of giving cigarettes as gifts, a common practice for establishing and maintaining interpersonal relationships in Chinese society...equating gifting cigarettes to loved ones and colleagues with giving them omens that portend future diseases and death from smoking” (Huang et al., 2014, p. 2). Campaign messages were broadcast through several media outlets, including TV advertisements, mobile media on buses and trains, billboards and posters for four weeks in over

30 major Chinese cities. In an evaluation of the GCGH campaign, Huang and colleagues (2014) found that, although recall of the campaign was low among participants at 14%, individuals that recalled the campaign were more likely to disagree that cigarettes are good gifts and demonstrated increased knowledge of smoking harms compared to those that did not recall the campaign, and that disagreeing that giving cigarettes are good gifts was higher in intervention cities than control cities. The authors note that low recall rate may have been due to the short duration of the campaign. However, this experience indicates that public education and awareness campaigns regarding “sin” products do have a significant effect on Chinese individuals, with the lesson learned that impact may be greater with longer duration. Moreover, using aspects of the Chinese culture such as *guanxi*, which as mentioned earlier is a deeply engrained practice, to promote reduction rather than increases in problematic consumption may be particularly applicable to the issue of alcohol use.

Alcohol use and alcohol-related problems are emerging as a threat to the public health and welfare of the Chinese population. Without adequate policies to address these issues, it is foreseeable that this trend is likely to continue. While previous literature has provided documentation of this growing problem, policy alternatives have yet to be determined. The research presented in these three papers provides the initial bases for the Chinese government to adopt alcohol policy strategies that are most appropriate and applicable to the country’s situation. Paper 1 found that the drinking patterns among socio-demographic groups vary greatly between China and Western countries. Specifically, women represent a group that exhibits increasing risk for problematic alcohol consumption similar to Western-based study findings and supporting the hypothesis that, with increasing modernization and Westernization, gender gaps in drinking behavior will diminish. However, younger persons exhibit less problematic alcohol consumption compared to older age group, suggesting that older Chinese individuals may be less aware of the problems associated with excessive alcohol consumption. Also in contrast to drinkers in Western countries, employed individuals are more likely to consume more alcohol and be heavier drinkers. Papers 2 and 3 found that the association between drinking behaviors in China and factors such as the influence of availability/access to alcohol and utilization of healthcare services are very similar between China and Western countries, *independent of socio-demographic differences in non-drinking, drinking, and problem-drinking groups*.

The implications of these three papers taken together are that while policies fostering education, prevention and screening interventions should differ in terms of target at-risk groups, policies aimed at environmental/public health prevention for limiting access and availability and fostering healthcare utilization among problem drinkers are likely applicable cross-nationally. Despite differences in the Chinese context, these patterns are similar. Future studies should examine whether other factors amenable to policy intervention are similarly associated with drinking behaviors.



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