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ARTICLE

Effects of hypertension diagnoses on alcohol consumption among Chinese Adults—A Two-dimensional regression discontinuity analysis

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Abstract
Exploiting the fact that hypertension is diagnosed when a person's blood pressure reading exceeds a medically specified threshold (90 mmHg for diastolic blood pressure or 140 mmHg for systolic blood pressure), this study estimates the effect of a first-ever hypertension diagnosis on Chinese adults' alcohol consumption using a two-dimensional regression discontinuity design. Analyzing data on 10,787 adults from the China Health and Nutrition Survey, our estimation reveals that hypertension diagnoses based on diastolic blood pressure readings exert a number of desirable effects. Hypertensive adults' drinking frequency and the incidence of excessive drinking among them were reduced by 1.2 times/week and 17.9 percentage points, respectively, about three years after the diagnosis. Meanwhile, their beer and Chinese spirits (*Baijiu*) intakes were reduced by 518.6 ml/week and 194.8 ml/week, respectively. Interestingly, we also found modest evidence that hypertension diagnoses based on diastolic blood pressure readings *increase* Chinese adults' wine intake, suggesting a substitution pattern upon hypertension diagnoses. In contrast, based on systolic blood pressure readings, no significant effects of hypertension diagnoses on alcohol consumption were found.

Keywords: hypertension; diagnosis; health information; alcohol consumption; regression discontinuity design

JEL classifications: D12; I12; Q18

I. Introduction

Alcohol drinking has long been an integrated part of China's food culture (Yen, Yuan and Liu, 2009), playing an essential role in many important social occasions, such as traditional festivals, family reunions, and business networking. Yet despite its social and cultural values, excessive alcohol drinking may impose a heavy health burden on alcohol consumers, raising the likelihood of developing chronic illnesses such as hypertension, hepatitis, and brain damage (Zahr, Kaufman and Harper, 2011; Zhao et al., 2020). Currently, the number of alcohol-related deaths in China ranks the highest among all countries worldwide (Griswold et al., 2018). Even so, per capita alcohol consumption among Chinese residents has been on the rise in recent decades. From 2005 to 2016, China's per capita alcohol consumption rose from 4.1 liters to 7.2 liters, representing the largest increase globally during that period (World Health Organization, 2018). In 2020 alone, 4,048 million nine-liter cases of beer, 828 million nine-liter cases of Chinese spirits (*Baijiu*), and 414 million nine-liter cases of wine were consumed in China.[1] The rapidly rising trends of both alcohol consumption and chronic disease prevalence have led many experts to call for curbing alcohol consumption in China (Jiang, Room and Hao, 2015).

Regarding the relationship between health and alcohol consumption, an important question remains largely unanswered: Will alcohol consumers alter their drinking behavior—especially in a healthy way—upon receiving notifications about their (worsened) health status, say, being diagnosed with a chronic condition? How chronic disease diagnoses may affect patients' behavior is of both academic interest and policy relevance. If, for example, chronic disease diagnoses fail to serve as a wake-up call for alcohol drinkers to stop (heavy) drinking, effective early interventions and related policies may be implemented before their chronic conditions become more severe. However, identifying the causal effects of disease diagnoses on alcohol consumption is challenging due to two potential problems. First, there might be reverse causality operated from alcohol consumption to disease diagnoses, disguising the real effect of disease diagnoses. Second, there might exist unobserved confounding factors, such as genetic markups,[2] that affect both disease diagnoses and alcohol consumption, creating a spurious correlation between them.

The present study circumvents these problems by exploiting the unique medical criteria for hypertension diagnoses to identify the effect of diagnoses of this particular condition. Two unique features of hypertension render it an interesting case to study. First, despite the high prevalence of hypertension worldwide and the fact that it is relatively easy to detect during regular health checkups,[3] less than half (42%) of all hypertensive patients were diagnosed and treated (Zhou et al., 2021). Worse still,

[1]Source: https://www.statista.com/statistics/1255465/china-alcohol-consumption-volume-by-type/#statisticContainer (accessed on December 1, 2023). The relatively small amount of wine consumption lies in the short history of wine consumption in China. While China has a long history of winemaking, the popularity of red wine among the less affluent groups has surged only in the past few decades. Winemaking in China could date back to sometime between 7000 BC and 9000 BC (Li et al., 2018). Initially, grape wines were reserved for the entertainment of high-ranking government officials and wealthy households. More recently, with the globalization of wine supply, the widespread presence of Western restaurants, the booming bar and nightclub industry, red wine has now become more and more popular among both the affluent and the less privileged groups (Xu et al., 2014).

[2]For example, Wang et al. (2022) recently provided evidence that genetically-determined alcohol intolerance can affect individuals' income through their alcohol consumption behavior.

[3]On the global scale, the number of individuals aged 30-79 years diagnosed with hypertension has doubled in the last two decades. As of 2019, 626 million women and 652 million men globally had been diagnosed with hypertension (Zhou et al., 2021).

if not treated in time, hypertension may lead to other non-communicable chronic illnesses, such as stroke, coronary artery disease, and heart failure (Mendis, Puska and Norrving, 2011). Thus, the effect of hypertension diagnosis, if convincingly identified, will inform not only hypertension management but also the prevention and treatment of other chronic illnesses. Secondly, unlike most other chronic diseases, hypertension has clear, medically set thresholds for diagnoses based on continuous biomarker (i.e., blood pressure) readings. More specifically, a person will be diagnosed with hypertension if his/her systolic blood pressure (SBP) reading attains 140 mmHg or his/her diastolic blood pressure (DBP) reading reaches 90 mmHg (Unger et al., 2020). These criteria provide a unique opportunity to apply a regression discontinuity (RD) design to identify the effects of hypertension diagnoses on one's alcohol consumption behavior. To the extent that individuals with blood pressure readings just below and just above a given threshold are otherwise comparable, an RD design can provide credible estimates of hypertension-diagnosis effects.

Taking into account the fact that there are two thresholds for hypertension diagnoses, we follow Wong, Steiner, and Cook (2013) and Dai et al. (2022) and apply a two-dimensional RD design to a panel dataset involving 10,787 adults from the China Health and Nutrition Survey (CHNS), a large-scale household survey covering more than ten Chinese provinces. Our two-dimensional RD analyses reveal that *first-ever* hypertension diagnoses based on DBP readings exert some desirable effects, reducing hypertensive adults' drinking frequency by 1.2 times/week, beer consumption by 518.6 ml/week, Chinese spirits (*Baijiu*) by 194.8 ml/week and the incidence of excessive drinking by 17.9 percentage points 3-4 years later. Interestingly, we also found modest evidence that hypertension diagnoses *increase* Chinese adults' wine intake, suggesting a substitution pattern upon hypertension diagnoses based on DBP readings. In contrast, based on the SBP rule, no significant effects of hypertension diagnoses on alcohol consumption were found.

These analyses make two contributions to the literature. First, to the best of our knowledge, our study is among the very few that identify the causal effects of hypertension diagnosis on alcohol-drinking behaviors, likely the first in China. The existing literature primarily concerns the impact of health information on individuals' nutrient intake, smoking behavior, and physical activities (Zhao, Konishi and Glewwe, 2013; Slade and Kim, 2014; Rabel et al., 2019; Zeng and Shimokawa, 2020; Dai et al., 2022), paying little attention to its impact on alcohol consumption, a key component of China's food culture that has potential health concerns. Our study fills this gap. Second, beyond identifying the effects of hypertension diagnoses, we demonstrate how these effects may vary across consumers' drinking behaviors (whether to drink and drinking frequency) and types of alcoholic beverages (beer, *Baijiu*, and wine), which have rarely been examined in previous studies on alcohol consumption, especially in the context of China.

The remainder of the paper is structured as follows. The next section briefly reviews the relevant literature. Section 3 describes our data. Section 4 develops a two-dimensional RD framework for identifying the effects of hypertension diagnoses. Section 5 reports and discusses our main findings. The final section draws conclusions and offers several policy implications.

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II. Relevant literature

Behavioral theories have long emphasized the importance of "cues" in motivating behavioral changes (Hochbaum, 1958; Rosenstock, 1974). A specific cue labeled "teachable moment" describes an unexpected health event that could induce individuals to adopt risk-reducing behaviors (McBride, 2003). The diagnosis of a chronic condition serves as one such teachable moment (Keenan, 2009; Xiang, 2016; Oster, 2018; Hu, Chen and Zhang, 2021; Qin, 2022). Among known chronic conditions, hypertension has received considerable attention because of its high prevalence and its role as a risk factor for other chronic diseases, including other cardiovascular and cerebrovascular diseases that impose significant threats to the patient's health status and quality of life (Cheungpasitporn et al., 2016). As such, hypertension diagnoses provide a valuable opportunity to understand how an individual's health behavior (alcohol drinking in our context) may alter in response to a teachable moment.

Previous studies have examined the impact of hypertension diagnoses on individuals' smoking behaviors, dietary patterns, and physical activities (Zhao, Konishi and Glewwe, 2013; Slade and Kim, 2014; Rabel et al., 2019; Zeng and Shimokawa, 2020; Dai et al., 2022). Although conducted in different countries, these studies consistently found that individuals reduced their cigarette consumption after a hypertension diagnosis (Zeng and Shimokawa, 2020; Dai et al., 2022). In contrast, the effects of hypertension diagnosis on individuals' dietary patterns and physical activities found in the literature are less conclusive. While its impacts on protein and total energy intakes are not statistically significant, hypertension diagnosis has been found to significantly reduce patients' daily fat and sodium intakes (Zhao, Konishi and Glewwe, 2013; Slade and Kim, 2014; Dai et al., 2022). Regarding physical activities, Rabel et al. (2019) found that individuals who were already physically active tended to remain active after being diagnosed with hypertension; however, the diagnosis did not necessarily make physically inactive individuals more active.

While controlling alcohol consumption is a key component of the medical advice for hypertensive patients, studies investigating whether hypertensive patients actually adhere to this recommendation are still lacking. To the best of our knowledge, only two studies have explored the hypertension-alcohol drinking nexus, and the findings of these studies are also mixed. Liang and Chikritzhs (2011), applying multivariate logistic regressions to analyze a cross-sectional dataset from Australia, found that respondents diagnosed with hypertension were *more* likely to reduce or stop alcohol drinking. In contrast, Kerr et al. (2017), fitting generalized estimating equation (GEE) models using retrospective data from the United States, found *no* statistically significant association between hypertension diagnosis and the likelihood of heavy drinking.

Research examining the hypertension diagnosis-alcohol consumption relationship in China, where the world's largest hypertensive population resides (World Health Organization, 2003),[4] is largely nonexistent. Even though this relationship has been examined in Australia and the U.S., findings from these countries may not inform the case of China, given the different drinking preferences and food cultures

[4]In 2019, approximately 256.7 million adults aged between 30 and 79 in China were diagnosed with hypertension (World Health Organization, 2023).

across countries. For example, beer is the most commonly consumed alcoholic beverage in Australia and the U.S.—as of 2016, beer consumption accounted for 40% and 47% of total alcohol intake in these two countries, respectively. In contrast, *Baijiu is* the most demanded alcoholic beverage in China, accounting for 67% of China's total (pure) alcohol intake in 2016 (World Health Organization, 2018). These differences suggest that the impact of health information on alcohol consumption in China might also differ from those found in Australia and the U.S.

Note also that the hypertension diagnosis-alcohol consumption relationships found in the Australian (Liang and Chikritzhs, 2011) and American studies (Kerr et al., 2017) discussed above may not be causal. For example, the findings of both studies might be subject to self-selection bias due to their reliance on self-reported data collected through drop-and-collect or computer-assisted telephone interviews. It is possible that individuals who consume more alcohol are more concerned about their hypertension status and are more likely to participate in the survey, which might have biased the estimates of the hypertension-diagnosis effect in these studies.

In light of these knowledge gaps, our study attempts to estimate the causal effect of hypertension diagnosis on Chinese adults' alcohol consumption by applying an RD design to data drawn from the CHNS, a large-scale longitudinal household survey covering more than ten Chinese provinces.

III. Data

a. Survey and sampling

The China Health and Nutrition Survey (CHNS) is an ongoing survey jointly designed, implemented, and managed by the Carolina Population Center at the University of North Carolina and the National Institute for Nutrition and Health at the Chinese Center for Disease Control and Prevention. The original survey was launched in 1989, covering nine Chinese provinces that vary substantially in geographical conditions, economic development, public resources, and health indicators: Liaoning, Heilongjiang, Jiangsu, Shandong, Henan, Hubei, Hunan, Guangxi, and Guizhou. The project was later expanded to include three municipalities (Beijing, Chongqing, and Shanghai) in 2011 and three more provinces (Shaanxi, Yunnan, and Zhejiang) in 2015.[5] Nine follow-up surveys were conducted between 1991 and 2015.[6] Approximately 7,200 households and over 30,000 individuals have participated in the project.[7]

In the first wave (conducted in 1989), the CHNS adopted a multistage, random sampling procedure to select target households. Cities and rural counties were first stratified by income levels (low, middle, and high) in each of the nine original project provinces. Four counties from each province were then randomly selected by a weighted sampling scheme; the provincial capital and a lower-income city

[5]For more information on the specific characteristics of these provinces, see the official CHNS website https://www.cpc.unc.edu/projects/china/about/proj_desc/chinamap (accessed on September 12, 2023).

[6]More specifically, these follow-up surveys were conducted in 1991, 1993, 1997, 2000, 2004, 2006, 2009, 2011 and 2015.

[7]Source: https://www.cpc.unc.edu/projects/china (accessed on September 12, 2023).

were selected whenever feasible.[8] Villages and townships within the selected counties and urban/suburban communities within the selected cities were chosen randomly. Information on sampled individuals' socio-demographic characteristics, economic activities, food consumption, and nutrition intake, as well as health behaviors, was collected through face-to-face interviews. Physical examinations, including blood pressure measurements, have also been performed by professionally trained investigators during the survey since the 1993 wave (Zeng and Shimokawa, 2020; Dai et al., 2022).

To obtain the "cleanest" estimates of the effects of hypertension diagnoses, we focus on identifying the effects of *first-ever* hypertension diagnoses, as subsequent diagnoses are likely to have weaker effects or pick up the effects of earlier diagnoses. The panel structure of the CHNS data allows us to tell whether a hypertension diagnosis recorded in a given wave t was the first-ever hypertension diagnosis for a sampled individual. In each wave, the respondent was asked, "Have you ever been diagnosed with [X]," where X refers to a particular chronic disease. With this information, we identified the first-ever hypertension diagnosis if a person reported being diagnosed with hypertension in wave t but answered "No" to the same question above before t. Note also that since blood pressure readings were measured *during* the survey, hypertension diagnoses recorded in a given wave will not affect a respondent's alcohol consumption behavior reported in the same wave, as the information on alcohol consumption recorded during a given wave refers to the situation sometime *before* that wave ("last year"). Given such a data structure, we focus on examining the (relatively long-term) effect of first-ever hypertension diagnoses in wave t on individuals' alcohol consumption observed in the next wave $t+1$ (about three years later).

Our empirical analysis focuses on data collected from eight CHNS waves (1993, 1997, 2000, 2004, 2006, 2009, 2011 and 2015). We excluded the first two waves (1989 and 1991) from the analysis because the 1989 wave did not collect information on respondents' blood pressure readings or their drinking behavior (Zeng and Shimokawa, 2020; Hu, Chen and Zhang, 2022), and the 1991 survey only collected data on respondents' drinking frequency but not the amounts of alcoholic beverages (beer, wine, and *Baijiu*) consumed. Given these limitations, we chose 1993 as the starting year of analysis. Information collected in 1993-2011 was used to define individuals' hypertension status (at t) and that in 1997-2015 to construct measures of their alcohol drinking behaviors (detailed below) about three years later (at $t+1$).

Several sample restrictions were further applied to form the final analytical sample: (1) we limited our attention to respondents who reported consuming alcohol at t; (2) we excluded individuals under age 18 at the time of the survey, given the extremely low incidence of hypertension among them (Zhao, Konishi and Glewwe, 2013) and the fact that they are not supposed to consume alcoholic beverages;[9] (3) given our focus placed on the effects of *first-ever* hypertension diagnoses at t, we excluded individuals diagnosed with hypertension at t-1 (the previous wave). Applying these restrictions yielded

[8] In two provinces, a large city other than the provincial capital was selected.

[9] China does not impose an official minimum drinking age, but the *Law on the Protection of Minors* prohibits the sale of alcoholic beverages to children under the age of 18. Source: http://jl.people.com.cn/n2/2020/1207/c349771-34459263.html (accessed on September 12, 2023).

an analytical sample with 10,787 observations. The actual sample sizes used in the regressions are somewhat smaller, as they are determined by the optimal bandwidths (usually within the ±15-mmHg interval around the diagnostic threshold) chosen by the algorithm proposed by Calonico, Cattaneo, and Titiunik (2014) and Imbens and Kalyanaraman (2012).

Table 1, panel B, depicts the profile of sample respondents in wave *t*. In the analytical sample, 84.2% are male—the high proportion of males resulted from our sample restriction to include only those who consumed alcohol at *t*, as noted above. The average sampled individual was 44.5 years old, completed 7.7 years of formal education, and came from a four-membered family with a household income per capita of roughly 8,428 Yuan (≈1,352 U.S. dollars at constant 2015 prices).[10] About 85.5% of the sampled individuals were married, and approximately 24.4% held an official urban residential permit (*Hukou*). Slightly more than 80% of the sampled individuals were working at the time of the survey.

b. Blood pressure readings and hypertension diagnoses

Blood pressure readings, the treatment assignment variable (or "forcing" variable or "running" variable used in the literature) in our RD design, were obtained through detailed physical examinations performed by the CHNS team. In each survey wave, medically trained investigators recorded each respondent's systolic and diastolic blood pressure readings on three consecutive days and took the average of the three readings. An individual is diagnosed with hypertension if his/her average SBP reaches 140 mmHg or his/her average DBP attains 90 mmHg (Zeng and Shimokawa, 2020; Dai et al., 2022).[11] After completing the physical examinations, the respondents were informed of their blood pressure readings and the result of their hypertension diagnosis. However, those diagnosed with hypertension were not explicitly informed of the severity of their condition. Nor were they prescribed specific treatments during the survey (Zhao et al., 2020). As such, the effects identified in this study are those of hypertension diagnoses rather than specific medical advice or prescribed treatments usually associated with them. It is possible that hypertensive respondents sought medical advice or treatments after the diagnosis, but the effects of these follow-up procedures should be interpreted as part of the effect of hypertension diagnosis.

c. Outcome variables

The CHNS recorded detailed information on sampled respondents' general drinking behaviors (drinking incidence and drinking frequency) and their consumption of the three most commonly consumed alcoholic beverages in China (beer, *Baijiu*, and wine), greatly facilitating our construction of indicators that capture different aspects of Chinese adults' alcohol consumption behavior.

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[10]One U.S. dollar ≈ 6.23 Yuan in 2015.

[11]Source: https://www.who.int/news-room/fact-sheets/detail/hypertension (accessed on September 12, 2023).

Table 1. Summary statistics

	(1)		(2)		(3)		(4)	
	All		Non-hypertensive (SBP < 140 & DBP < 90)		Hypertensive (SBP ≥ 140 or DBP ≥ 90)		Difference = (3)-(2)	
Sample	Mean	SD	Mean	SD	Mean	SD	Mean	SE
A. Drinking behaviors (t+1)								
Drinking (dummy, 1=yes)	0.690	0.463	0.683	0.465	0.711	0.453	0.028*	0.015
Drinking frequency (times/week)	3.545	2.797	3.520	2.793	3.875	2.802	0.355***	0.104
Beer consumption (ml/week)	699.204	1400.937	690.732	1398.327	661.484	1354.682	−29.248	45.540
Baijiu (Chinese spirits) consumption (ml/week)	325.838	577.040	323.487	573.937	366.516	633.563	43.029**	18.532
Wine consumption (ml/week)	19.866	116.815	18.479	112.082	24.551	130.665	6.072	3.784
Total alcohol intake (g/week)	169.314	267.355	166.796	264.979	189.819	291.328	23.023**	9.042
Excessive drinking (dummy, 1=yes)	0.306	0.461	0.301	0.459	0.344	0.475	0.042***	0.015
B. Pre-determined factors (*t*)								
Age (years)	44.485	13.789	43.761	13.512	51.183	13.834	7.421***	0.398
Male (dummy, 1=yes)	0.842	0.364	0.831	0.375	0.885	0.319	0.053***	0.011
Education (years)	7.731	3.845	7.763	3.810	7.100	4.109	−0.663***	0.114
Urban residents (dummy, 1=yes)	0.244	0.429	0.239	0.427	0.257	0.437	0.018	0.013
Household income per capita (adjusted by CPI)	8428.915	11511.068	8282.149	10581.423	8896.256	11929.555	614.108*	316.843

(*Continued*)

Table 1. (*Continued.*)

	(1)		(2)		(3)		(4)	
	All		Non-hypertensive (SBP < 140 & DBP < 90)		Hypertensive (SBP ≥ 140 or DBP ≥ 90)		Difference = (3)-(2)	
Sample	Mean	SD	Mean	SD	Mean	SD	Mean	SE
Household size	4.042	1.535	4.062	1.514	3.847	1.602	−0.215***	0.045
Working (dummy, 1=yes)	0.801	0.399	0.812	0.390	0.728	0.445	−0.085***	0.011
Married (dummy, 1=yes)	0.855	0.352	0.858	0.349	0.874	0.332	0.016	0.010
Han (dummy, 1=yes)	0.844	0.362	0.834	0.372	0.863	0.344	0.030***	0.011
N	10,787		8,570		1,347			

Source: Author's calculation using data from the China Health and Nutrition Survey (1993-2015).
Note: Total alcohol intake is computed as "total alcohol intake = beer consumption × 0.04 g/ml+ wine consumption × 0.10 g/ml+ *Baijiu* consumption × 0.52 g/ml," but due to missing values of some of the variables involved, the relationship between the mean values of these variables may not exactly follow this formula.
***$p<0.01$, **$p<0.05$, *$p<0.1$.

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1. Drinking behavior

The first set of outcome variables of interest concerns one's general drinking behavior. Specifically, two variables were constructed to measure whether a respondent (still) consumed alcoholic beverages around the time of the survey at $t+1$ given his/her hypertension diagnosis result at t and, if yes, his/her drinking frequency. In each survey wave, the CHNS team asked each respondent two questions regarding his/her general drinking behavior. The first question was: "Did you drink beer, wine,[12] or *Baijiu* last year?" The answer to this question was used to create a binary indicator of drinking incidence (=1 if "Yes" and =0 if "No"). If the answer was "Yes," the respondent was further asked: "How often did you drink?" The responses to choose from include: "Almost every day," "3-4 times a week," "1-2 times a week," "1-2 times a month," "less than once a month," and "I don't know." Since the respondents provided their answers by selecting one of the aforementioned intervals, for ease of analysis and interpretation, we created a continuous variable measuring "weekly drinking frequency" by assigning the midpoints of the chosen intervals as its values (—a value of "missing" was assigned to the response of "I don't know").

2. Alcohol intake

The second set of outcome variables concerns Chinese adults' weekly consumption of beer, *Baijiu*, and wine. Since in the raw data, beer consumption was measured in *bottles* (one bottle = 600 ml), while wine and *Baijiu* consumption in *liang* (one *liang* = 50 grams), we converted the units of weekly consumption of these three alcoholic beverages uniformly into grams (g) for ease of comparison. To further calculate one's total alcohol intake, we followed Ren, Castro Campos and Loy (2020) and multiplied the weekly consumption of these beverages by the percentage of their alcohol content (i.e., 0.04 g/ml for beer, 0.52 g/ml for *Baijiu*, and 0.10 g/ml for wine), to obtain the weekly alcohol intake associated with the consumption of each of these three beverages. Summing across the three beverages yields the total alcohol intake, based upon which an "excessive drinking" variable was further constructed. As suggested by the dietary guidelines for Chinese residents (Chinese Nutrition Society, 2016), a male (female) with an average daily total alcohol intake of more than 25 g (15 g) is considered an excessive alcohol drinker.

Table 1, panel A, presents descriptive statistics of the outcome variables discussed above for all respondents in the analytical sample (column 1) and separately for non-hypertensive (column 2) and hypertensive respondents (column 3). In the full sample (column 1), 69.0% of the respondents reported consuming alcoholic beverages at $t+1$, with an average frequency of 3.5 times/week. Among the three types of alcoholic beverages considered, beer is the most consumed by volume, with an average intake of 699.2 ml/week, followed by *Baijiu*, with an average of 325.8 ml/week; wine is the least consumed, with an average intake of 19.9 ml/week. It should be noted that the alcohol content in *Baijiu* is much higher than in beer. As such, translated from the above volume measures, sample respondents' alcohol intake from drinking *Baijiu* (169.4 g/week) is much higher than that from drinking beer (28.0 g/week); that from drinking wine (2.0 g/week) is the smallest.

[12] In the CHNS, "wine" refers to "grape wine (including various colored wines and rice wine)."

A quick comparison between columns (2) and (3) suggests that, in general, hypertensive respondents drink significantly more than non-hypertensive ones in terms of drinking incidence, drinking frequency, *Baijiu* consumption, total alcohol intake, and incidence of excessive drinking. However, it bears mentioning that these comparisons were made without addressing potential confounding issues. As shown in Table 1, panel B, there are significant differences in socioeconomic characteristics, including age, gender, ethnicity, household size, years of education, household income per capita, and working status, between hypertensive and non-hypertensive respondents. To identify the causal effect of hypertension diagnoses on alcohol consumption, methods that can adequately address potential confounding issues are needed. The following section develops such a method.

IV. Empirical methods

The fact that a person's hypertensive status is "switched on" when his/her DBP (diastolic blood pressure) or SBP (systolic blood pressure) reading, a continuous treatment assignment variable, smoothly passes a clearly specified threshold naturally suggests an RD framework for identifying the effects of hypertension diagnoses. To the extent that individuals with blood pressure readings just above and just below the threshold are comparable in all aspects except their diagnosis results, an RD design effectively addresses unobserved confounding. But unlike the standard RD design that involves only one threshold, there are two thresholds for hypertension diagnoses: 90 mmHg for DBP readings and 140 mmHg for SBP readings. As such, a two-dimensional RD design is needed.

Four approaches to implementing a two-dimensional RD design have been proposed in the literature. The first approach simply picks one set of blood pressure readings as the treatment assignment variable, ignoring the potential contamination of diagnoses based on the other set of blood pressure readings. For example, Zhao, Konishi and Glewwe (2013) focus on SBP readings in their study:

$$\delta^{S|D\_all} = \lim_{S \searrow 140} E\left[y_{i,t+1}|S_{i,t} = 140\right] - \lim_{S \nearrow 140} E\left[y_{i,t+1}|S_{i,t} = 140\right], \tag{1}$$

where $y_{i,t+1}$ is an outcome variable of interest (e.g., total alcohol intake) observed at time $t+1$ for individual i; $S_{i,t}$ is his/her SBP readings measured at t; $\lim_{S \nearrow 140} E\left[y_{i,t+1}|S_{i,t} = 140\right]$ and $\lim_{S \searrow 140} E\left[y_{i,t+1}|S_{i,t} = 140\right]$ are, respectively, the left-hand and right-hand limits of the outcome variable y, as the value of the treatment assignment variable approaches 140 mmHg, the SBP-based threshold for hypertension diagnosis.

To circumvent potential contamination of "treatment" based on DBP readings, a refinement, adopted by Zeng and Shimokawa (2020), is to exclude observations with SBP readings over 90 mmHg while estimating equation (1):

$$\delta^{S|D<90} = \lim_{S \searrow 140} E\left[y_{i,t+1}|S_{i,t} = 140, D_{i,t} < 90\right] - \lim_{S \nearrow 140} E\left[y_{i,t+1}|S_{i,t} = 140, D_{i,t} < 90\right], \tag{2}$$

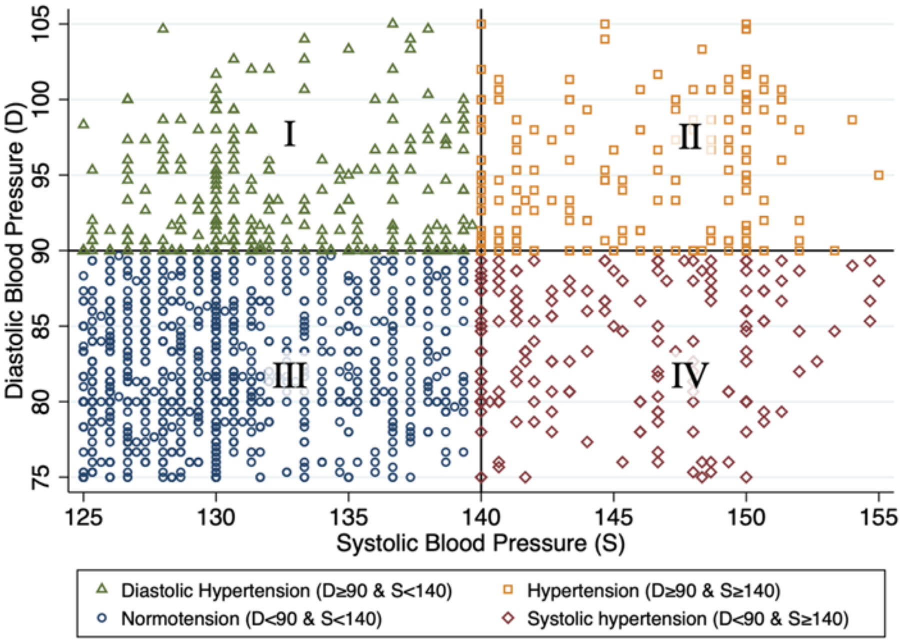

Figure 1. Illustration of identification strategies.
Source: Author's own creation.

where $D_{i,t}$ is individual *i*'s DBP readings at time *t*. But, as with the estimator $\delta^{S|D\_all}$ defined in (1), $\delta^{S|D<90}$ lacks the power to identify the effect of hypertension diagnosis based on DBP readings.

The third approach, recommended by Wong, Steiner, and Cook (2013) and recently adopted by Dai et al. (2022), identifies the effects of hypertension diagnosis based on *both* sets of blood pressure readings. In essence, this approach performs two *separate* RD estimations, each focusing on one of the two diagnostic thresholds while controlling for potential contamination of "treatment" defined by the other threshold. Specifically, one first implements a one-dimensional RD design, say, $\delta^{S|D<90}$ defined in (2), using SBP readings as the treatment assignment variable (and 140 mmHg as the threshold), excluding all observations with DBP readings above 90 mmHg (i.e., those in quadrants I and II of Figure 1). Then, one switches the roles of DBP and SBP readings and performs another RD analysis along the DBP dimension:

$$\delta^{D|S<140} = \lim_{D\searrow 90} E\left[y_{i,t+1}|D_{i,t} = 90, S_{i,t} < 140\right]$$

$$- \lim_{D\nearrow 90} E\left[y_{i,t+1}|D_{i,t} = 90, S_{i,t} < 140\right]. \quad (3)$$

In implementing $\delta^{D|S<140}$ defined in (3), observations with SBP readings above 140 mmHg (i.e., those in quadrants II and IV of Figure 1) are excluded. Estimating $\delta^{D|S<140}$

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and $\delta^{S|D<90}$ one at a time, this approach identifies the impact of hypertension diagnosis based on each diagnostic rule *separately*; individuals who are hypertensive by *both* diagnostic rules (i.e., those in quadrant II of Figure 1) are also naturally excluded from the analysis.

The final approach, proposed by Imbens and Zajonc (2009), accommodates both diagnostic rules simultaneously. This approach uses the "distance" to the diagnostic "boundary" jointly defined by the two diagnostic rules as the treatment assignment variable. Specifically, the distance from the *diagnostic boundary* for individual *i* at time *t*, $Dist_{i,t}$, is defined as:

$$Dist_{i,t} = \begin{cases} \sqrt{(S_{i,t}-140)^2 + (D_{i,t}-90)^2}, \textit{if } S_{i,t} \geq 140, D_{i,t} \geq 90; \\ D_{i,t} - 90, \textit{if } S_{i,t} < 140, D_{i,t} \geq 90; \\ -\min(140 - S_{i,t}, 90 - D_{i,t}), \textit{if } S_{i,t} < 140, D_{i,t} < 90; \\ S_{i,t} - 140, \textit{if } S_{i,t} \geq 140, D_{i,t} < 90. \end{cases} \quad (4)$$

The corresponding RD estimator is:

$$\delta^{S\&D} = \lim_{Dist \searrow 0} E\left[y_{i,t+1} | Dist_{i,t} = 0\right] - \lim_{Dist \nearrow 0} E\left[y_{i,t+1} | Dist_{i,t} = 0\right]. \quad (5)$$

Of all four estimators discussed above, our preferred ones are $\delta^{S|D<90}$, defined in (2), and $\delta^{D|S<140}$, defined in (3). Compared with one-dimensional RD estimators that exploit only one diagnostic threshold for identification (e.g., $\delta^{S|D\_all}$ defined in (1)), the preferred estimators have the advantage of avoiding potential contamination of "treatment" defined by the other threshold. Compared with the "distance-to-joint-diagnostic-boundary" estimator defined in (4) and (5), our preferred estimators, $\delta^{S|D<90}$ and $\delta^{D|S<140}$, show how individuals may respond to different treatment assignment rules differently. For comparison purposes, we report estimation results based on all other estimators in Appendix Table A1.

All estimations reported in this study were performed using the statistical package STATA (Version 17). All estimates reported are non-parametric estimates. Based on the common practice in recent RD studies, the actual sample size used in each of the models reported below is determined by the optimal bandwidth chosen to minimize the mean squared error (MSE) at the diagnostic threshold (Imbens and Kalyanaraman, 2012; Calonico, Cattaneo and Titiunik, 2014; Calonico et al., 2017). Finally, recall from section 3.1 that each sampled respondent diagnosed with hypertension at time *t* has a "baseline" observation at *t*-1 with normal blood pressure readings (with both SBP and DBP readings below their respective thresholds) in the sample. To account for these individuals' repeated appearances in the analytical sample, we follow Liang and Zeger's (1986) "one-level-up" strategy and cluster the standard errors at the community level to avoid serial correlation issues. Results remain very similar when the standard errors are clustered at the individual level or the blood pressure reading level.[13]

[13]Detailed results are not reported in the paper but are available upon request.

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V. Results

a. Main results

This section reports our main results of estimating the effects of first-ever hypertension diagnoses on Chinese adults' alcohol consumption behavior. Table 2 presents non-parametric RD estimates based on our preferred estimators, i.e., $\delta^{S|D<90}$ defined in (2), and $\delta^{D|S<140}$ defined in (3). The general finding is that first-ever hypertension diagnoses by the DBP diagnostic rule significantly impact Chinese adults' alcohol consumption in various aspects; in contrast, those by the SBP rule have no significant impact.

Column 2 of Table 2 reports the estimates based on the DBP rule. Although first-ever hypertension diagnoses by the DBP rule did not significantly alter Chinese adults' drinking incidence (panel A), they significantly reduced their drinking frequency by 1.2 times/week about three years later (i.e., observed in the next wave) (panel B). The reduction in drinking frequency translates into a reduction in beer consumption by 518.6 ml/week (panel C) and a reduction in *Baijiu* consumption by 194.8 ml/week (panel D). Compared with the mean amounts of beer (690.7 ml/week) and *Baijiu* consumption (323.5 ml/week) among non-hypertensive individuals, these reductions are rather sizable. Although these reductions did not lead to a statistically significant drop in total alcohol intake (panel F)—presumably due to an insignificant *increase* (by 21.6 ml/week) in wine consumption (panel E)—they did lead to a significant drop (by 17.9 percentage points) in the incidence of excessive drinking (panel G).

The left panels of Figure 2 visualize these findings: a drop at the 90-mmHg threshold is clearly shown for drinking frequency (panel c), beer consumption (panel e), *Baijiu* consumption (panel g), and the proportion of excessive drinking (panel m). Meanwhile, no significant jump was revealed for drinking incidence (panel a), wine consumption (panel i), or total alcohol intake (panel k), at the threshold.[14]

Column (3) of Table 2 reports the estimates based on the SBP diagnostic rule. Unlike hypertension diagnoses based on the DBP rule, which exerts several significant impacts on Chinese adults' alcohol consumption (column 2), those based on the SBP rule do not seem to impact Chinese adults' alcohol consumption in a notable way. All non-parametric RD estimates reported in this column are statistically insignificant. The corresponding RD figures (Figure 2, right panels) also reveal no significant jumps at the 140-mmHg threshold for SBP readings.

Non-parametric RD estimates based on other estimators discussed in section 4 are reported in Appendix Table A1. The one-dimensional RD estimates reported in columns (1) and (2) are quite comparable to their counterparts reported in Table 2, albeit less statistically significant, presumably due to contamination of treatment defined by the other diagnostic rule. The estimates based on the "distance-to-joint-diagnostic-boundary" estimator $\delta^{S\&D}$, defined in equations (4) and (5), are mostly insignificant (column 3). This is not surprising because the estimates based on $\delta^{S\&D}$

[14]Note that there seem to be outliers lying near the top of panels d, h and l of Figure 2 around the cut-off, which may "drag" the fitted regression curves up and lead to biased RD estimates. Yet dropping these data points hardly changed our RD estimates or the shape of the fitted curves. Detailed results are available upon request.

Table 2. Non-parametric RD estimates of the effects of first-ever hypertension diagnosis on Chinese adults' alcohol consumption

	(1)	(2)	(3)
Estimator	Mean [SD]	RD estimates based on DBP readings (threshold: DBP = 90)	RD estimates based on SBP readings (threshold: SBP = 140)
Sample individuals	Non-hypertensive (SBP < 140 & DBP < 90)	Systolic normal (SBP <140)	Diastolic normal (DBP < 90)
A. Drinking (1=yes)	0.683 [0.466]	0.017 (0.077)	0.074 (0.085)
Optimal bandwidth		5.361	14.371
N	7,382	7,984	7,655
B. Drinking frequency (times/week)	3.520 [2.793]	−1.177** (0.493)	−0.439 (0.606)
Optimal bandwidth		6.454	13.926
N	4,961	5,388	5,129
C. Beer consumption (ml/week)	690.732 [1398.327]	−518.550** (225.854)	255.092 (239.849)
Optimal bandwidth		8.032	12.915
N	6,478	7,010	6,740
D. Baijiu (Chinese spirits) consumption (ml/week)	323.487 [573.937]	−194.801** (99.004)	−26.885 (126.490)
Optimal bandwidth		8.375	13.472
N	7,008	7,580	7,272
E. Wine consumption (ml/week)	18.479 [112.082]	21.604 (21.625)	−3.788 (19.772)
Optimal bandwidth		6.225	10.390
N	6,317	6,850	6,571
F. Total alcohol intake (g/week)	166.796 [264.979]	−65.244 (47.623)	3.955 (68.070)
Optimal bandwidth		6.896	12.557
N	6,071	6,578	6,321
G. Excessive drinking (1=yes)	0.301 [0.459]	−0.179** (0.076)	0.037 (0.114)
Optimal bandwidth		8.108	13.094
N	6,133	6,643	6,386

Source: Author's analysis using data from the China Health and Nutrition Survey (1993-2015).
Notes: Non-parametric RD estimates with the triangular kernel and the associated optimal bandwidths are reported. The analytical sample size is determined by the optimal bandwidth chosen to minimize the mean squared error at the threshold (Calonico, Cattaneo and Titiunik, 2014).
Standard deviations in brackets; standard errors in parentheses, clustered at the community level.
***p<0.01, **p<0.05, *p<0.1.

are the "weighted averages" of the estimates based on $\delta^{S|D<90}$ (the SBP-based estimator) and $\delta^{D|S<140}$ (the DBP-based estimator). Since the estimates based on the former are mostly insignificant (Table 2, column 3), the inclusion of systolic hypertensive

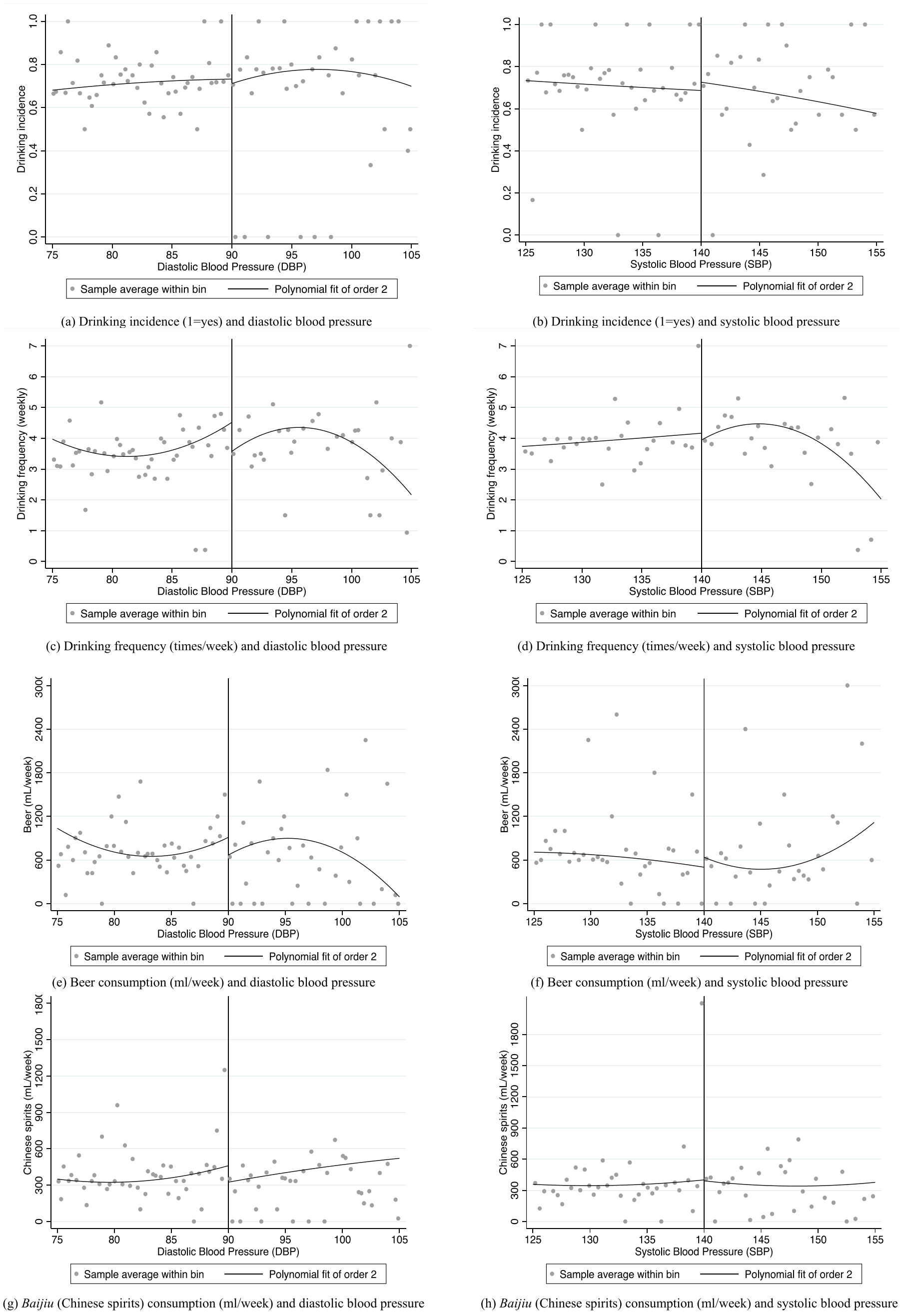
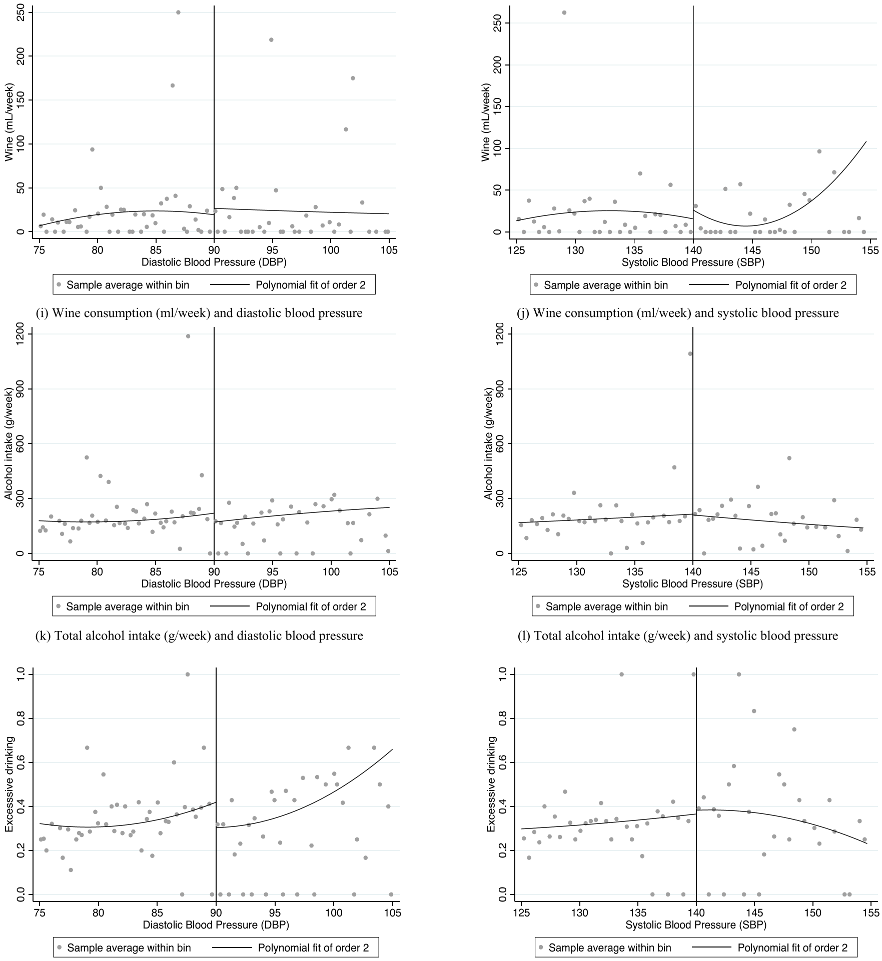


Figure 2. Two-way relationships between blood pressure readings and alcohol consumption.
Source: Author's analysis using data from the China Health and Nutrition Survey (1993-2015).



(i) Wine consumption (ml/week) and diastolic blood pressure

(j) Wine consumption (ml/week) and systolic blood pressure

(k) Total alcohol intake (g/week) and diastolic blood pressure

(l) Total alcohol intake (g/week) and systolic blood pressure

(m) Excessive drinking (1=yes) and diastolic blood pressure

(n) Excessive drinking (1=yes) and systolic blood pressure

Figure 2. (Continued.)

individuals in the estimation introduces a certain amount of noise in the "weighted averages," making them mostly insignificant.

b. Validity of the identifying assumption

The validity of the above results (Table 2) hinges on the plausibility of the identification assumption needed for our RD design, i.e., all factors except the hypertension diagnosis status vary continuously when the treatment assignment variable, blood pressure readings, passes the thresholds smoothly. If this assumption is plausible, one would expect to see little impact of hypertension diagnoses on characteristics determined prior to the diagnoses. To verify this, we ran a set of non-parametric RD regressions using a set of pre-determined socio-demographic characteristics as dependent variables.

Subject to data availability, the pre-determined characteristics examined include respondents' age, gender, years of schooling, residential area (urban versus rural), household income, and household size. The results, visualized in Appendix Figure A1, reveal essentially no "jumps" on these characteristics at either the DBP (left panels) or the SBP threshold (right panels). It is impossible to perform a similar check on unobserved characteristics, but the continuity in observed pre-determined characteristics at the two diagnostic thresholds greatly strengthens the validity of our RD design and findings.

A valid RD design also requires that sample respondents did not manipulate the values of the treatment assignment variable so as to land on one side of the diagnostic threshold (Lee and Lemieux, 2010), which implies that there be no "clustering" of blood pressure readings on either side of a given threshold. Appendix Figure A2, plotting the densities of the two blood pressure readings, reveals no evidence of such clustering around the thresholds.

c. Alternative bandwidths

Recall that the RD estimates reported in Table 2 were obtained based on the optimal bandwidths chosen by the algorithm devised by Calonico, Cattaneo and Titiunik (2014). These estimates could be biased if the corresponding estimation sample (determined by the optimal bandwidth) still includes too many observations with blood pressure readings far away from the diagnostic thresholds—in some cases, the optimal bandwidth exceeds 15 mmHg. Arguably, individuals with a DBP reading of 75 mmHg and those with a reading of 105 mmHg may not have comparable health status (at least in terms of the severity of hypertension). Even though we have controlled for a flexible (non-parametric) function of blood pressure readings, the treatment assignment variable, on either side of the threshold in all regressions reported above, the fitted function may not be sufficiently flexible to eliminate the incomparability problem. To see how the inclusion of "far-away" observations may impact our estimation results, Appendix Table A2 reports non-parametric RD estimates using observations within *half* (column 1) and *twice* (column 2) of the optimal bandwidth based on the DBP diagnostic rule (i.e., using the estimator $\delta^{D|S<140}$, defined in equation 3).[15] Reassuringly, the new estimates are all quantitatively comparable to their counterparts reported in Table 2, column 2, suggesting that the choice of bandwidth is not a major concern in our context.

d. Other confounding factors

Even though the above checks help strengthen the validity of our RD estimates of the effects of first-ever (DBP-based) hypertension diagnoses on Chinese adults' alcohol consumption behavior, our estimates might still pick up the influence of other founding factors. One possibility is that our estimated effects of DBP-based hypertension diagnoses reflect the effects of other chronic conditions that are triggered by hypertension.

[15]We only report results based on the DBP diagnostic rule because, as Table 2 shows, only hypertension diagnoses based on this rule affect sample respondents' alcohol consumption behavior. Results based on the SBP rule are not reported but are made available upon request.

Table 3. Influence of confounding factors at the hypotension diagnosis thresholds

	(1)	(2)
Estimator	RD estimates based on DBP readings (threshold: DBP =90)	RD estimates based on SBP readings (threshold: SBP =140)
Sample	Systolic normal (SBP $<$ 140)	Diastolic normal (DBP $<$ 90)
A. Other chronic diseases (=1 if a person has diabetes, myocardial infarction, apoplexy, or asthma)	−0.023 (0.026)	0.043 (0.039)
Optimal bandwidth	5.353	13.165
N	9,247	8,874
B. Working (=1 if yes)	0.036 (0.071)	−0.051 (0.086)
Optimal bandwidth	5.934	14.817
N	9,174	8,799
C. Household income (Yuan, in log)	−0.106 (0.240)	−0.016 (0.191)
Optimal bandwidth	5.321	18.270
N	9,145	8,777
D. Household expenditure (Yuan, in log)	0.308 (0.719)	0.805 (0.706)
Optimal bandwidth	6.690	15.328
N	9,175	8,805

Source: Author's analysis using data from the China Health and Nutrition Survey (1993-2015).
Notes: One U.S. dollar ≈ 6.23 Yuan in 2015. Non-parametric RD estimates with the triangular kernel and the associated optimal bandwidths are reported. The analytical sample size is determined by the optimal bandwidth chosen by minimizing the mean squared error at the threshold (Calonico, Cattaneo and Titiunik, 2014).
Standard errors in parentheses, clustered at the community level.

As noted above, if not detected early and appropriately controlled, hypertension may lead to other chronic conditions, such as stroke, coronary artery disease, and heart failure (Mendis, Puska and Norrving, 2011). Many of these other chronic illnesses may also affect one's food and beverage consumption behavior (Oster, 2018; Krämer, Kumar and Vollmer, 2021; Hu, Chen and Zhang, 2022). Since our outcome variables were observed *a few years after* the sample respondents' hypertension diagnoses, our RD estimates may capture the influence of other chronic conditions developed during this time window rather than the impact of hypertension diagnoses *per se*.

To check this possibility, we ran additional RD regressions treating the incidence of any of the other chronic conditions recorded in the CHNS data (i.e., diabetes, myocardial infarction, apoplexy, and asthma) as the outcome variable. The results, reported in panel A of Table 3, reveal virtually no associations between hypertension diagnoses and the incidence of any other chronic conditions. While it is impossible to check for other chronic diseases (e.g., cancer and hepatitis) that are unavailable in the CHNS data, the finding reported in Table 3, panel A, alleviates the concern about the confounding effects of other chronic conditions. A related concern is that the inclusion of sampled individuals with other chronic conditions in the estimation sample might "contaminate" the effects of hypertension diagnoses in that earlier diagnoses of other chronic conditions may have induced changes in hypertensive individuals' alcohol consumption behavior. To check this possibility, we excluded individuals who had been diagnosed with other chronic diseases before their (first-ever) hypertension diagnoses and re-estimated our main RD models reported in Table 2. The results, not reported here but made available upon request, remained almost identical to those reported in Table 2.

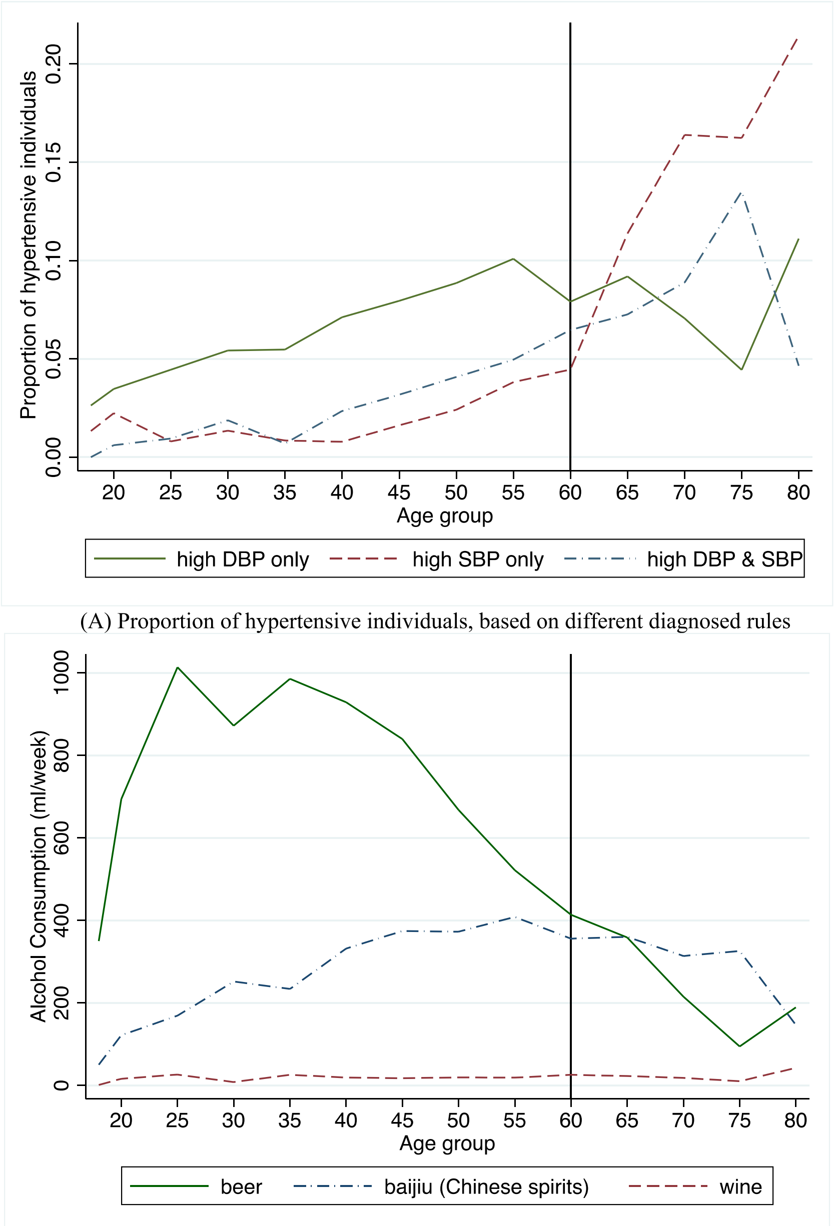
The effects of hypertension diagnoses reported in Table 2 may also pick up the influence of non-medical factors. Again, since the outcome variables discussed above were observed about three years after one's hypertension diagnosis result was revealed, it is possible that the diagnosis had caused non-medical factors related to one's alcohol consumption behavior, such as work status and income, to change. Table 3, panels B-D, reports the results of examining several of such factors. These results suggest that hypertension diagnoses had essentially no effects on whether one was working at the time of the survey (panel B), one's annual household income (panel C), or household expenditure (panel D). Again, the insignificant correlations between hypertension diagnoses and these factors help reduce the potential concern about confounding factors.

e. Differential effects based on different diagnostic rules: the role of age

Recall that, unlike hypertension diagnoses based on the DBP rule (Table 2, column 2), those based on the SBP rule did not appear to significantly affect Chinese adults' drinking habits (Table 2, column 3). Yet why do Chinese adults respond differently to hypertension diagnoses based on different diagnosis rules? Age plays an important role in two regards. First, the incidence of diastolic and systolic hypertension varies with age but exhibits distinct patterns. Many studies have shown that "high DBP but normal SBP" readings are more commonly observed among young and middle-aged individuals, whereas "high SBP but normal DBP" readings are more common among older adults (Fang et al., 1995; Tate et al., 1995; Nürnberger et al., 2003; Kanegae et al., 2017). Consistent with this pattern, panel A of Figure 3 shows that high DBP readings predominate among our sample individuals (roughly) under the age of 60. In contrast, among older adults, the proportion with high SBP readings surpasses that with high DBP readings and increases rapidly with age.[16] These patterns suggest that the differences in the effects of hypertension diagnoses based on different rules may reflect the varying responses of alcohol drinkers from different age groups when exposed to new health information.

Second, individuals' drinking intensity also varies with age. Figure 3, panel B, shows that while Chinese adults' wine and *Baijiu* consumption do not vary significantly with age, their beer consumption does. In particular, their beer consumption is much higher than their wine and *Baijiu* consumption but drops significantly after age 45; it becomes lower than *Baijiu* consumption after age 65.

[16]The fluctuations after the age of 75 are likely due to the very small sample size involved (2.68%).



(A) Proportion of hypertensive individuals, based on different diagnosed rules

(B) Alcohol consumption (ml/week) by age groups

Figure 3. Hypertension diagnoses and alcohol consumption by age groups.
Source: Author's analysis using data from the China Health and Nutrition Survey (1993-2015).

These two age-related patterns suggest one possible explanation for the differential impacts of DBP-based and SBP-based hypertension diagnoses found above. Chinese adults are more responsive to DBP-based diagnosis than SBP-based diagnosis when they are relatively younger because the former is more common among younger and middle-aged adults (Figure 3, panel A). However, they become less responsive to hypertension diagnoses (either DBP-based or SBP-based) when they become older because their alcohol consumption (especially beer consumption and total alcohol intake) drops rapidly with age (Figure 3, panel B).

To test this explanation, we ran separate RD regressions for sample individuals under 60 and those above 60 based on both diagnostic rules. The results, reported in Table 4, provide evidence that supports this explanation: individuals under 60 are responsive to hypertension diagnoses (but only to DBP-based diagnoses), while those aged 60 and above are not significantly affected by hypertension diagnoses based on either the SBP or the DBP rule.

This exploration reveals another informative finding: for individuals under age 60, while their beer and *Baijiu* consumption drop in response to DBP-based hypertension diagnoses, their wine consumption *increases* by 40.4 ml/week, an effect that is significant at the 0.079 level (Table 4, column 2).[17] This finding suggests that we may find a more pronounced pattern when focusing on a subsample that is more responsive to (DBP-based) hypertension diagnoses. To test this possibility, we divide the sample of individuals under age 60 by their residential area (urban versus rural), as urban residents consume more alcohol than rural ones and are more likely to be sensitive to hypertension diagnoses.[18] The results reported in Table 5 confirm this expectation. Despite its much smaller size, the urban sample yields point estimates of hypertension-diagnosis effects that are, in general, larger than those found in the rural sample (with the only exception of beer consumption). In particular, the impact of hypertension diagnosis on wine consumption is much larger and statistically more significant for the urban sample than in the rural sample.

The increase in wine consumption, together with the significant decline in beer and *Baijiu* consumption, suggests a substitution effect upon (DBP-based) hypertension diagnosis. It is likely that Chinese adults substitute wine consumption for beer and *Baijiu* consumption upon (DBP-based) hypertension diagnosis because they believe wine has more health benefits compared with beer and *Baijiu*. In fact, red wine offers various health benefits that have been scientifically documented. For example, resveratrol, presenting in the skin and tannins of red grapes, has been extensively researched and demonstrated to induce vasorelaxation, elicit anti-inflammatory responses, and scavenge reactive oxygen species (ROS), thus helping to protect heart function (Das et al., 2010, 1999; Wang et al., 2005). In addition, resveratrol has been found to exhibit antitumor activity and neuroprotective abilities (Castello and Tessitore, 2005; Zhuang et al., 2003). Knowing these benefits, some (young urban) hypertensive individuals who enjoy alcohol drinking may decide to switch from beer and *Baijiu* consumption to wine consumption while having to cut back on total alcohol intake.

[17] Recall that the effect of DBP-based hypertension diagnoses on wine consumption for all relevant individuals, reported in from Table 2, column (2), is also positive, although not statistically significant.

[18] In our analytical sample, the average weekly wine consumption among urban individuals (31.2 ml/week) is nearly twice that among rural individuals (16.2 ml/week).

Table 4. Non-parametric RD estimates of the effects of first-ever hypertension diagnoses on alcohol consumption by age

	(1)	(2)	(3)	(4)
	Age < 60		Age ≥ 60	
Estimator	RD estimates based on DBP readings (threshold: DBP = 90)	RD estimates based on SBP readings (threshold: SBP = 140)	RD estimates based on DBP readings (threshold: DBP = 90)	RD estimates based on SBP readings (threshold: SBP = 140)
Sample individual	Systolic normal (S < 140)	Systolic normal (D < 90)	Systolic normal (S < 140)	Systolic normal (D < 90)
A. Drinking (1=yes)	−0.004 (0.076)	0.146 (0.131)	−0.001 (0.142)	−0.073 (0.124)
Optimal bandwidth	6.244	10.189	6.437	15.626
N	6460	6094	1524	1561
B. Drinking frequency (times/week)	−1.076** (0.543)	−1.051 (0.882)	−1.189 (1.208)	0.228 (0.976)
Optimal bandwidth	6.282	11.268	5.451	14.579
N	4410	4140	978	989
C. Beer consumption (ml/week)	−544.368** (257.848)	136.425 (555.572)	−651.274 (573.502)	−3.353 (248.896)
Optimal bandwidth	7.921	8.648	6.523	12.668
N	5638	5327	1372	1413
D. Baijiu consumption (ml/week)	−220.508** (104.597)	−94.834 (216.109)	−173.542 (191.364)	−3.328 (159.613)
Optimal bandwidth	9.127	9.897	9.116	13.170
N	6093	5748	1487	1524

(*Continued*)

Table 4. (*Continued.*)

	(1)	(2)	(3)	(4)
	Age < 60		Age ≥ 60	
Estimator	RD estimates based on DBP readings (threshold: DBP = 90)	RD estimates based on SBP readings (threshold: SBP = 140)	RD estimates based on DBP readings (threshold: DBP = 90)	RD estimates based on SBP readings (threshold: SBP = 140)
Sample individual	Systolic normal (S < 140)	Systolic normal (D < 90)	Systolic normal (S < 140)	Systolic normal (D < 90)
E. Wine consumption (ml/week)	29.017 (19.865)	40.375* (22.965)	0.203 (71.165)	−23.858 (41.074)
Optimal bandwidth	6.816	6.442	5.487	11.501
N	5490	5175	1360	1396
F. Total alcohol intake (g/week)	−93.190* (52.018)	−14.848 (101.775)	3.132 (91.358)	8.175 (83.251)
Optimal bandwidth	7.107	9.938	6.690	12.267
N	5250	4952	1328	1369
G. Excessive drinking (1=yes)	−0.211** (0.083)	0.235 (0.210)	−0.140 (0.120)	−0.030 (0.148)
Optimal bandwidth	8.320	7.107	9.932	12.901
N	5304	5005	1339	1381

Data source: Author's analysis using data from the China Health and Nutrition Survey (1993-2015).
Notes: Non-parametric RD estimates with the triangular kernel and the associated optimal bandwidths are reported. The analytical sample size is determined by the optimal bandwidth chosen by minimizing the mean squared error at the threshold (Calonico, Cattaneo and Titiunik, 2014).
Standard errors in parentheses, clustered at the community level.
*** $p<0.01$, ** $p<0.05$, *$p<0.1$.

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Table 5. Non-parametric RD estimates of the effects of first-ever DBP-based hypertension diagnoses on alcohol consumption among individuals aged under 60 (rural vs. urban)

	(1)	(2)
	Rural	Urban
Estimator	RD estimates based on DBP readings (threshold: DBP = 90)	RD estimates based on DBP readings (threshold: DBP = 90)
Sample individual	Systolic normal (S < 140)	Systolic normal (S < 140)
A. Drinking (1=yes)	−0.041 (0.082)	−0.060 (0.156)
Optimal bandwidth	6.956	5.327
N	4,908	1,552
B. Drinking frequency (times/week)	−0.510 (0.711)	−2.600*** (0.954)
Optimal bandwidth	5.243	5.875
N	3,390	1,020
C. Beer consumption (ml/week)	−581.534** (280.698)	−432.909 (514.954)
Optimal bandwidth	7.927	10.056
N	4,259	1,379
D. Baijiu (Chinese spirits) consumption (ml/week)	−174.984 (123.977)	−343.883* (195.826)
Optimal bandwidth	8.993	9.283
N	4,663	1,430
E. Wine consumption (ml/week)	12.264 (20.248)	81.487** (40.786)
Optimal bandwidth	7.495	6.238
N	4,187	1,303
F. Total alcohol intake (g/week)	−95.651 (60.034)	−103.184 (82.182)
Optimal bandwidth	7.442	8.355
N	4,007	1,243
G. Excessive drinking (1=yes)	−0.194** (0.098)	−0.252* (0.135)
Optimal bandwidth	8.689	6.800
N	4,053	1,251

Data source: Author's analysis using data from the China Health and Nutrition Survey (1993-2015).
Notes: Non-parametric RD estimates with the triangular kernel and the associated optimal bandwidths are reported. The analytical sample size is determined by the optimal bandwidth chosen by minimizing the mean squared error at the threshold (Calonico, Cattaneo and Titiunik, 2014).
Standard errors in parentheses, clustered at the community level.
***p<0.01, **p<0.05, *p<0.1.

VI. Conclusion

Exploiting the fact that hypertension is diagnosed when a person's blood pressure reading exceeds a medically determined threshold, this paper estimates the effects of a first-ever hypertension diagnosis on Chinese adults' alcohol consumption behavior based on a two-dimensional RD design. Analyzing a longitudinal dataset (CHNS) involving 10,787 Chinese adults (aged 18 or above), our analysis reveals that first-ever hypertension diagnoses based on DBP readings exert some desirable effects, significantly reducing hypertensive adults' drinking frequency, their beer and *Baijiu* (Chinese spirits) consumption, and the incidence of excessive drinking about three years later. Further analyses reveal that young and middle-aged adults (under age 60) are more responsive to DBP-based hypertension diagnosis than older adults (age 60 and above). Interestingly, younger urban adults were found to substitute wine consumption for beer and *Baijiu* consumption upon (DBP-based) hypertension diagnosis. In contrast, no significant effects of SBP-based hypertension diagnoses on alcohol consumption were found.

Two policy implications can be derived from these findings. First, the alcohol consumption curbing effects of (DBP-based) hypertension diagnosis underscore the necessity of regular hypertension screening. With the rising incidence of hypertension among younger populations, routine health checkups enable early detection and timely treatment of hypertension and related illnesses. Healthier behavioral changes may also be triggered Second, the insignificant impact of hypertension diagnoses among older adults highlights the need for special attention paid to the alcohol-drinking habits of this specific population. Encouraging them to adopt a healthier lifestyle requires more than just routine health checkups. For example, an alcohol policy with strong legislation and comprehensive health promotion may be considered.

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Competing interests. The authors declare no competing interests.

References

Calonico, S., Cattaneo, M.D., Farrell, M.H. and Titiunik, R. (2017). Rdrobust: Software for Regression-discontinuity Designs. *The Stata Journal: Promoting Communications on Statistics and Stata*, 17(2), 372–404.

Calonico, S., Cattaneo, M.D. and Titiunik, R. (2014). Robust Non-parametric Confidence Intervals for Regression-Discontinuity Designs. *Econometrica*, 82(6), 2295–2326.

Castello, L., Tessitore, L., 2005. Resveratrol inhibits cell cycle progression in U937 cells. *Oncology Reports* 13, 133–137.

Cheungpasitporn, W., Thongprayoon, C., Srivali, N., Vijayvargiya, P., Andersen, C.A., Kittanamongkolchai, W., Sathick, I.J.J., Caples, S.M. and Erickson, S.B. (2016). The effects of napping on the risk of hypertension: a systematic review and meta-analysis, *Journal of Evidence-Based Medicine*, 9(4), 205–212.

Chinese Nutrition Society. (2016). *The Chinese Dietary Guidelines*. Available at: http://dg.cnsoc.org/article/04/8a2389fd5520b4f30155b41b364b23df.html (accessed 3 September 2023).

Dai, T., Jiang, S., Liu, X. and Sun, A. (2022). The effects of a hypertension diagnosis on health behaviors: A two-dimensional regression discontinuity analysis. *Health Economics*, 31(4), 574–596.

Das, D.K., Mukherjee, S., Ray, D., 2010. Resveratrol and red wine, healthy heart and longevity. *Heart Failure Reviews* 15, 467–477.

Das, D.K., Sato, M., Ray, P.S., Maulik, G., Engelman, R.M., Bertelli, A.A., Bertelli, A., 1999. Cardioprotection of red wine: role of polyphenolic antioxidants. *Drugs Under Experimental and Clinical Research* 25, 115–120.

Fang, J., Madhavan, S., Cohen, H. and Alderman, M.H. (1995). Isolated diastolic hypertension: a favorable finding among young and middle-aged hypertensive subjects. *Hypertension*, 26(3), 377–382.

Griswold, M.G., Fullman, N., Hawley, C., Arian, N., Zimsen, S.R.M., Tymeson, H.D., et al. (2018). Alcohol use and burden for 195 countries and territories, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet*, 392(10152), 1015–1035.

Hochbaum, G.M. (1958). *Public Participation in Medical Screening Programs: A Socio-Psychological Study*. Washington, D.C.: U.S. Department of Health, Education, and Welfare, Public Health Service, Bureau of State Services, Division of Special Health Services, Tuberculosis Program. Available at: https://search.library.wisc.edu/catalog/999694547302121 (accessed 12 September 2023).

Hu, Y., Chen, Q. and Zhang, B. (2021). Can Chronic Disease Diagnosis Urge the Patients to Quit Smoking?—Evidence from the China Health and Nutrition Survey', *Risk Management and Healthcare Policy*. 14, pp.3059–3077.

Hu, Y., Chen, Q. and Zhang, B. (2022). Effects of chronic disease diagnoses on alcohol consumption among elderly individuals: longitudinal evidence from China. *BMJ Open*, 12(10), p.e062920.

Imbens, G. and Kalyanaraman, K. (2012). Optimal Bandwidth Choice for the Regression Discontinuity Estimator. *The Review of Economic Studies*, 79(3), pp.933–959.

Imbens, G. and Zajonc, T. (2009). Regression Discontinuity Design with Multiple Forcing Variables. *Working paper*. Available at: https://www.researchgate.net/publication/265317533_Regression_Discontinuity_Design_with_Multiple_Forcing_Variables.

Jiang, H., Room, R. and Hao, W. (2015). Alcohol and related health issues in China: action needed. *The Lancet Global Health*, 3(4), e190–e191.

Kanegae, H., Oikawa, T., Okawara, Y., Hoshide, S. and Kario, K. (2017). Which blood pressure measurement, systolic or diastolic, better predicts future hypertension in normotensive young adults? *The Journal of Clinical Hypertension*, 19(6), pp. 603–610.

Keenan, P.S. (2009). Smoking and Weight Change After New Health Diagnoses in Older Adults. *Archives of Internal Medicine*, 169(3), 237.

Kerr, W.C., Ye, Y., Greenfield, T.K., Williams, E., Lui, C.K., Li, L. and Lown, E.A. (2017). Changes in heavy drinking following onset of health problems in a U.S. general population sample. *Preventive Medicine*, 95, 47–51.

Krämer, M., Kumar, S. and Vollmer, S. (2021). Anemia, diet, and cognitive development: Impact of health information on diet quality and child nutrition in rural India. *Journal of Economic Behavior & Organization*, 190, 495–523.

Lee, D. and Lemieux, T. (2010). Regression discontinuity designs in economics. *Journal of Economic Literature*, 48(2), 281–355.

Liang, W. and Chikritzhs, T. (2011). Reduction in alcohol consumption and health status. *Addiction*, 106(1), 75–81.

Liang, K.-Y. and Zeger, S.L. (1986). Longitudinal data analysis using generalized linear models. *Biometrika*, 73(1), 13–22.

Li, H., Wang, H., Li, H., Goodman, S., van der Lee, P., Xu, Z., Fortunato, A., Yang, P., 2018. The worlds of wine: Old, new and ancient. *Wine Economics and Policy* 7, 178–182.

McBride, C.M. (2003). Understanding the potential of teachable moments: the case of smoking cessation. *Health Education Research*, 18(2), 156–170.

Mendis, S., Puska, P. and Norrving, B. (2011). Global Atlas on Cardiovascular Disease Prevention and Control. *World Health Organization*. Available at: https://www.who.int/publications/i/item/9789241564373.

Nürnberger, J., Dammer, S., Opazo Saez, A., Philipp, T. and Schäfers, R.F. (2003). Diastolic blood pressure is an important determinant of augmentation index and pulse wave velocity in young, healthy males. *Journal of human hypertension*, 17(3), 153–158.

Oster, E. (2018). Diabetes and Diet: Purchasing Behavior Change in Response to Health Information. *American Economic Journal: Applied Economics*, 10(4), 308–348.

Qin, W. (2022). A diagnosis of diabetes and health behavior maintenance in middle-aged and older adults in the United States: The role of self-efficacy and social support. *Preventive Medicine*, 155, Article 106958.

Rabel, M., Mess, F., Karl, F.M., Pedron, S., Schwettmann, L., Peters, A., Heier, M. and Laxy, M. (2019). Change in Physical Activity after Diagnosis of Diabetes or Hypertension: Results from an Observational Population-Based Cohort Study. *International Journal of Environmental Research and Public Health*, 16(21), Article 4247.

Ren, Y., Castro Campos, B. and Loy, J.-P. (2020). Drink and smoke; drink or smoke? The interdependence between alcohol and cigarette consumption for men in China. *Empirical Economics*, 58(3), 921–955.

Rosenstock, I.M. (1974). Historical Origins of the Health Belief Model. Health *Education Monographs*, 2(4), 328–335.

Slade, A.N. and Kim, H. (2014). Dietary Responses to a Hypertension Diagnosis: Evidence from the National Health and Nutrition Examination Survey (NHANES) 2007–2010. *Behavioral Medicine*, 40(1), 1–13.

Tate, R.B., Manfreda, J., Krahn, A.D. and Edward Cuddy, T. (1995). Tracking of blood pressure over a 40-year period in the University of Manitoba Follow-up Study, 1948–1988. *American Journal of Epidemiology*, 142(9), 946–954.

Unger, T., Borghi, C., Charchar, F., Khan, N.A., Poulter, N.R., Prabhakaran, D., Ramirez, A., Schlaich, M., Stergiou, G.S., Tomaszewski, M., Wainford, R.D., Williams, B. and Schutte, A.E. (2020). 2020 International Society of Hypertension Global Hypertension Practice Guidelines. *Hypertension*, 75(6), 1334–1357.

Wang, X., Chen, Q., Zhao, Q. and Zhu, C. (2022). Alcohol consumption and income: Evidence from one-sample and two-sample Mendelian randomizations. *Economics Letters*, 219, Article 110788.

Wang, Z., Zou, J., Cao, K., Hsieh, T.-C., Huang, Y., Wu, J.M., 2005. Dealcoholized red wine containing known amounts of resveratrol suppresses atherosclerosis in hypercholesterolemic rabbits without affecting plasma lipid levels. *International Journal of Molecular Medicine* 16, 533–540.

Wong, V.C., Steiner, P.M. and Cook, T.D. (2013). Analyzing Regression-Discontinuity Designs With Multiple Assignment Variables: A Comparative Study of Four Estimation Methods. *Journal of Educational and Behavioral Statistics*, 38(2), 107–141.

World Health Organization. (2018). *Global status report on alcohol and health 2018. Geneva: World Health Organization*. Available at: https://apps.who.int/iris/handle/10665/274603 (accessed 4 May 2023).

World Health Organization. (2023). Global report on hypertension: the race against a silent killer. Geneva: World Health Organization. Available: https://www.who.int/publications/i/item/9789240081062 (accessed 18 December 2023).

Xiang, X. (2016). Chronic Disease Diagnosis as a Teachable Moment for Health Behavior Changes Among Middle-Aged and Older Adults. *Journal of Aging and Health*, 28(6), 995–1015.

Xu, P., Zeng, Y.C., Song, S., Lone, T., 2014. Willingness to pay for red wines in China. *Journal of Wine Research* 25, 265–280.

Yen, S.T., Yuan, Y. and Liu, X. (2009). Alcohol consumption by men in China: A non-Gaussian censored system approach. *China Economic Review*, 20(2), 162–173.

Zahr, N.M., Kaufman, K.L. and Harper, C.G. (2011). Clinical and pathological features of alcohol-related brain damage. *Nature Reviews Neurology*, 7(5), 284–294.

Zeng, S. and Shimokawa, S. (2020). The effect of health information on smoking intensity: does addiction matter? *Applied Economics*, 52(22), 2408–2426.

Zhao, M., Konishi, Y. and Glewwe, P. (2013). Does information on health status lead to a healthier lifestyle? Evidence from China on the effect of hypertension diagnosis on food consumption. *Journal of Health Economics*, 32(2), 367–385.

Zhao, F., Liu, Q., Li, Y., Feng, X., Chang, H. and Lyu, J. (2020). Association between alcohol consumption and hypertension in Chinese adults: Findings from the CHNS. *Alcohol*, 83, 83–88.

Zhou, B., Carrillo-Larco, R.M., Danaei, G., Riley, L.M., Paciorek, C.J., Stevens, G.A., et al. (2021). Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. *The Lancet*, 398(10304), 957–980.

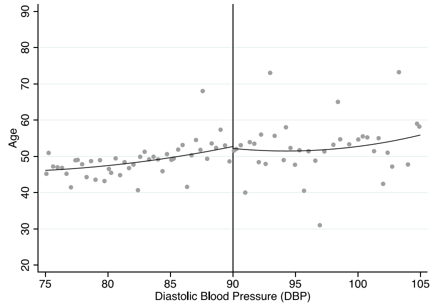
Zhuang, H., Kim, Y.-S., Koehler, R.C. and Doré, S., 2003. Potential mechanism by which resveratrol, a red wine constituent, protects neurons. *Annals of The New York Academy of Sciences* 993, 276–286.

Appendix: Supplementary and Figures Tables

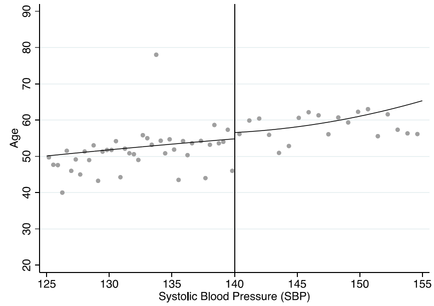
Table A1. Non-parametric RD estimates of the effects of hypertension diagnoses on alcohol consumption

Estimator	(1) RD estimates based on DBP readings (threshold: DBP =90)	(2) RD estimates based on SBP readings (threshold: SBP =140)	(3) RD estimates based on the distance to the joint boundary (SBP =140, DBP =90)
Sample	Full	Full	Full
A. Drinking incidence (1=yes)	−0.024 (0.041)	0.023 (0.071)	0.079 (0.081)
Optimal bandwidth	13.544	11.672	23.05
N	8,591	8,591	8,591
A. Drinking frequency (times/week)	−1.074*** (0.351)	−0.316 (0.517)	−1.417* (0.838)
Optimal bandwidth	10.781	11.513	17.203
N	5,809	5,809	5,809
B. Beer (ml/week)	−469.882** (196.796)	136.782 (197.638)	238.231 (167.804)
Optimal bandwidth	8.348	12.747	31.108
N	7,570	7,570	7,570
C. Baijiu (Chinese spirits) (ml/week)	−140.018* (78.742)	−29.869 (104.176)	−160.061 (108.477)
Optimal bandwidth	9.269	11.641	21.182
N	8,159	8,159	8,159
D. Wine (ml/week)	9.011 (13.365)	11.719 (17.336)	−25.034 (33.965)
Optimal bandwidth	10.361	11.164	26.293
N	7,398	7,398	7,398
E. Total alcohol intake (g/week)	−58.065* (33.360)	−9.234 (50.314)	−89.555 (63.376)
Optimal bandwidth	9.643	13.442	20.163
N	7,107	7,107	7,107
F. Excessive drinking (1=yes)	−0.140** (0.063)	0.004 (0.083)	−0.137 (0.094)
Optimal bandwidth	8.818	12.82	23.405
N	7,181	7,181	7,181

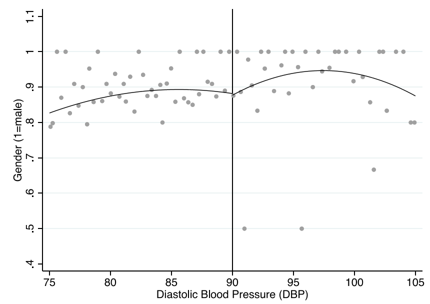
Data source: China Health and Nutrition Survey (1993-2015).
Notes: Non-parametric RD estimates with the triangular kernel and the associated optimal bandwidth are reported. The sample size (N) is the same for all panels in each column; the analytical sample size is determined by the optimal bandwidth chosen by minimizing the mean squared error at the threshold (Calonico, Cattaneo and Titiunik, 2014).
Standard errors in parentheses, clustered at the community level.
***$p<0.01$, **$p<0.05$, *$p<0.1$.



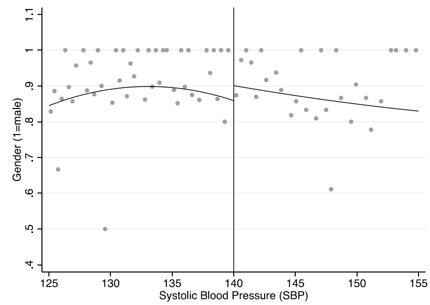
(a) Age and diastolic blood pressure



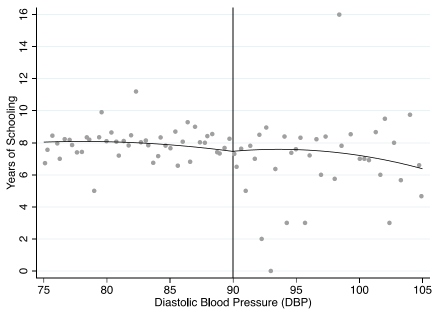
(b) Age and systolic blood pressure



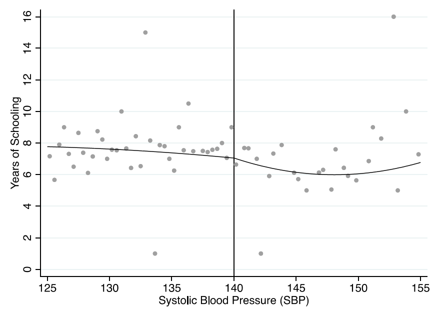
(c) Gender (1=male) and diastolic blood pressure



(d) Gender (1=male) and systolic blood pressure

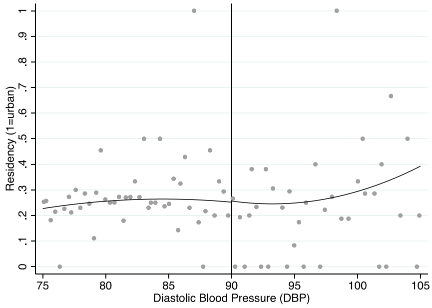


(e) Years of schooling and diastolic blood pressure

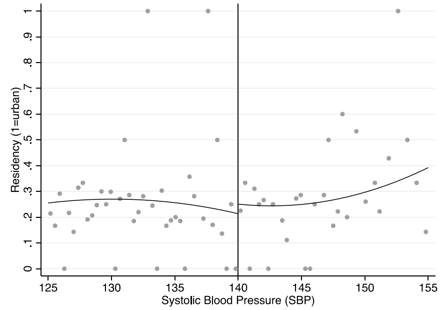


(f) Years of schooling and systolic blood pressure

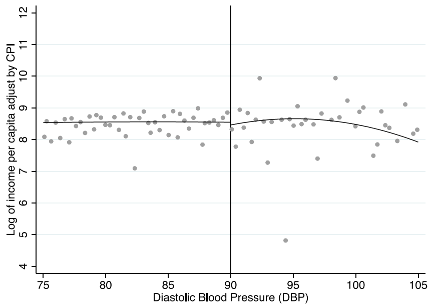
Figure A1. Continuity in pre-determined characteristics at hypertension diagnostic thresholds.
Source: Author's analysis using data from the China Health and Nutrition Survey (1993-2015).



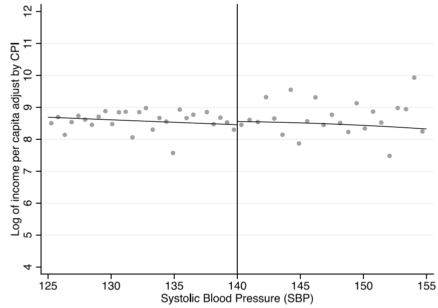
(g) Residential area (1=urban) and diastolic blood pressure



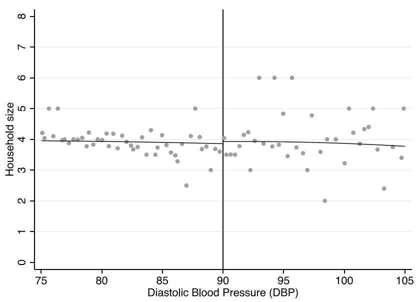
(h) Residential area (1=urban) and systolic blood pressure



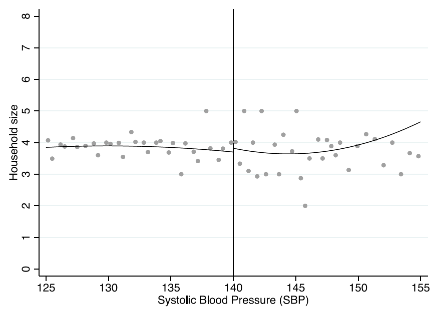
(i) Household income per capita and diastolic blood pressure



(j) household income per capita and systolic blood pressure

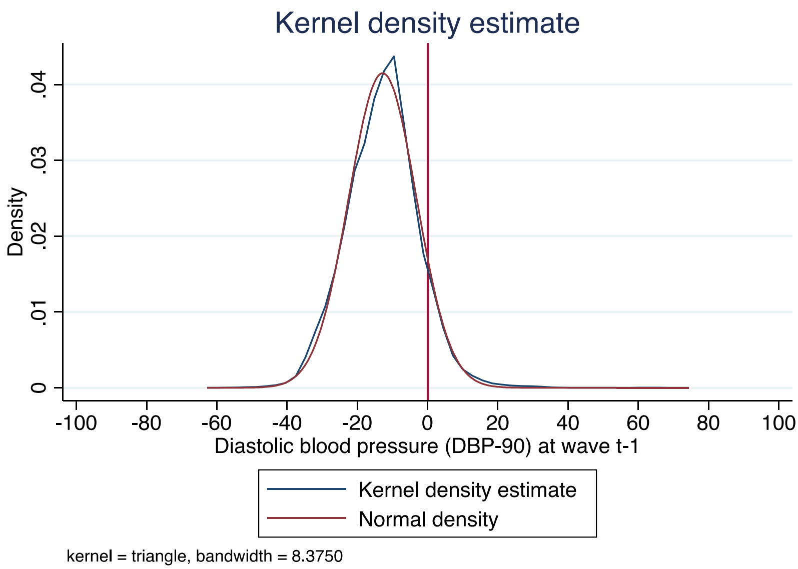


(k) Household size and diastolic blood pressure

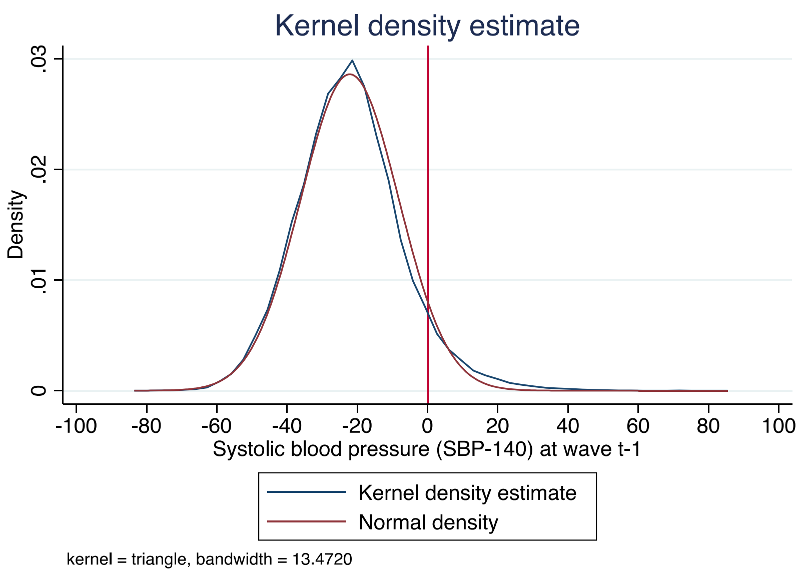


(l) Household size and systolic blood pressure

Figure A1. (Continued.)



(A) Density of diastolic blood pressure readings (centered)



(B) Density of systolic blood pressure readings (centered)

Figure A2. Densities of systolic and diastolic blood pressure readings.
Source: Author's analysis using data from the China Health and Nutrition Survey (1993-2015).

Table A2. Non-parametric RD estimates with different bandwidths

	(1)	(2)
Estimator	RD estimates based on DBP readings (threshold: DBP = 90)	RD estimates based on DBP readings (threshold: DBP = 90)
Sample individual	Systolic normal (SBP < 140)	Systolic normal (SBP < 140)
Bandwidth	Half the optimal bandwidth	Twice the optimal bandwidth
A. Drinking incidence (1=yes)	0.027	−0.041
	(0.078)	(0.047)
Optimal bandwidth	2.681	10.722
N	7,984	7,984
B. Drinking frequency (times/week)	−1.248***	−1.185***
	(0.475)	(0.343)
Optimal bandwidth	3.227	12.908
N	5,388	5,388
C. Beer (ml/week)	−439.655**	−218.307
	(222.935)	(161.771)
Optimal bandwidth	4.016	16.063
N	7,010	7,010
D. Baijiu (Chinese spirits) (ml/week)	−185.934*	−189.842***
	(97.688)	(64.535)
Optimal bandwidth	4.188	16.750
N	7,580	7,580
E. Wine (ml/week)	2.784	6.835
	(21.459)	(14.387)
Optimal bandwidth	3.113	12.450
N	6,850	6,850
F. Total alcohol intake (g/week)	−38.175	−74.792**
	(46.744)	(31.526)
Optimal bandwidth	3.448	13.791
N	6,578	6,578

(*Continued*)

Table A2. (*Continued.*)

Estimator	(1) RD estimates based on DBP readings (threshold: DBP = 90)	(2) RD estimates based on DBP readings (threshold: DBP = 90)
Sample individual	Systolic normal (SBP <140)	Systolic normal (SBP <140)
Bandwidth	Half the optimal bandwidth	Twice the optimal bandwidth
G. Excessive drinking (1=yes)	−0.145**	−0.147***
	(0.073)	(0.050)
Optimal bandwidth	4.054	16.216
N	6,643	6,643

Source: Author's analysis using data from the China Health and Nutrition Survey (1993-2015).
Notes: Non-parametric RD estimates with the triangular kernel and the associated optimal bandwidths are reported. The analytical sample size is determined by the optimal bandwidth chosen by minimizing the mean squared error at the threshold (Calonico, Cattaneo and Titiunik, 2014).
Standard errors in parentheses, clustered at the community level.
***p<0.01, **p<0.05, *p<0.1.

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