

Article

Does Health Insurance Reduce the Alcohol Consumption? Evidence from China Health and Nutrition Survey

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Abstract: Whether health insurance reduces alcohol consumption has been debated. To identify it, the authors used three-wave balance panel data from China Health and Nutrition Survey and applied a two-way fixed-effect model. The authors found that (1) health insurance reduces alcohol consumption, (2) the effect would be deducted when they have been diagnosed with diabetes, (3) the heterogeneity existed between old and young individuals as well as rural and urban areas, those old individuals would behave more cautious, and urban individuals would consume more alcohol. This study identified the effects of health insurance and the moderating effect of diabetes, which were helpful for policymakers to optimize health insurance policy to ensure the sustainability of health insurance and suggested that primary medical staff should assist patients to establish healthy living habits and reduce their risky behaviors.

Keywords: health insurance; ex-ante moral hazard; alcohol consumption



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1. Introduction

Health insurance is one of the policy instruments to promote national health. Different countries/regions have established their health insurance based on their national conditions. Since the new millennium, China is also trying to develop a health insurance system converging whole people. The new cooperative medical system established in 2002 is the most significant milestone of the Chinese health insurance system, which covers people living in rural areas, who cannot participate in basic health insurance since 1984. After entering the age of aging and epidemics, the sustainability of health insurance has become a concern, which puts forward the consideration of cost and effect of building health insurance. However, the cost and effect of building health insurance have been debated since RAND health insurance experiment, and the complexity is strengthened due to China's urban-rural differences. The core of this debate is whether health insurance promotes or reduces self-protection, i.e., decreasing alcoholic drinking, smoking, and other health-risk behaviors [1–3].

The academics who were pessimistic about health insurance acknowledged that health insurance redistributed income during medical service. But the redistribution of income reduces individual self-protect behaviors like alcoholic drinking and smoking [4,5]. Some empirical studies supported this opinion. Using Behavioral Risk Factor Surveillance System (BRFSS), Courtemanche et al. (2019) found that the Affordable care act (ACA) increased preventive care utilization but promoted alcoholic drinking [6]. Klick and Stratmann (2007) also used BRFSS data found body mass index(BMI) of insured diabetics would increase, which is a risky factor of diabetes [7]. Powell and Goldman(2021) found that nearly 53% of additional medical spending observed relative to adverse selection [8].

However, the redistribution of income also promotes the accessibility and utilization rate of health care, especially providing accessibility for the vulnerable [9]. Increasing utilization of health care enhanced the probability of accessing health literacy, the optimistic academics emphasized it. Although Klick and Stratmann (2007) found health insurance promoted unhealthy diet, they also found that the mandates improved access for diabetics to dieticians and diabetes educators, induced diabetics to behave more vigilant in their behavior. Soni (2020) found that the ACA promoted insured self-protection behavior, i.e., decreasing alcoholic drinking, smoking, and increasing the probability of exercising, with a 5-year panel data from BRFSS. Furthermore, health insurance has more positive effects among the vulnerable in the long term [10]. Some academics have their re-emphasized on whether health insurance convergence was a risk factor. Azagba et al. (2021) found that the health insurance convergence was unrelated to alcohol consumption, and alcohol consumption has its own trend under different economic cycles [11].

Due to different time intervals, and heterogeneous groups among different research, uncertainty remains. Currently, the population of China is entering an aging stage [12]. According to the communique of the seventh National population census of China, about 18.70% of China's population is over 60 years old. With the development of the economy, the prevalence of diabetes has also shown an increasing trend. Therefore, whether health insurance increases the alcohol consumption of diabetic patients has also become one of the key issues for the sustainability of health insurance. Therefore, the empirical result would provide not only strategies for policymakers to carry out a plan to promote national health and a fair health care system, but also directions for researchers of public health to make intervention.

There are also methodological benefits to focusing on with diabetes, that diabetes is manageable, and self-protection prevents severe complications to explore the potential mechanism behind the effect estimated [13,14]. The other important feature of diabetes is that the diagnosis implies the utilization of health insurance and can also represent obtaining medical advice from medical staff. Compared with the role of health insurance alone, research on ex-ante moral hazard should focus more on whether risky behavior would continue after consuming medical resources which may cause serious complications. Thus, we use whether the insured individual is diabetic as a moderator to estimate the difference.

Our main results indicate that (1) health insurance averagely reduces 3.595 g of daily alcohol consumption; (2) the difference between diabetics and non-diabetics who have been insured was significant, and the estimator showed that the differences between two groups was 8.184 g per day, which is larger than the sum of effects of health insurance and diagnosis of diabetes. The results explained one path why some researchers have found that health insurance promotes alcohol consumption. The group of respondents played an important role in identification. The robustness test showed that the results we found were robust. The population with health insurance will reduce their exposure to excessive alcohol consumption, but those with diabetes will increase their exposure to excessive alcohol consumption. We also have presented heterogeneity analysis by age and living area, the effect was significant when comparing young and old diabetic patients, and urban and rural diabetic patients.

This study contributes to the empirical result in making public health policy and health insurance policy, which proposes establishing a sustainable and fair system during epidemics and aging.

2. Materials and Methods

2.1. Data

This study uses data from CHNS, which is an open cohort initiated in 1989. The CHNS provides multi-stage, longitudinal data, which includes more than 30,000 individual participants. Specifically, we use three waves individual data, among 2009, 2011 and 2015, which includes health insurance type, diagnosis of diabetes, education, individual

gross income, household gross income, and other individual information. We removed individuals lost to follow-up and removed invalid data, which is −9 or NA in different columns, and 6765 observations maintained.

Using the three waves has three advantages, (1) we can identify the long-term effect of health insurance; (2) China's macro economy was relatively stable from 2009 to 2015, with controlling time fixed effect we can eliminate the external economic shock effect; (3) there has no major policy on health insurance system across the three waves, thus we can use two-way fixed effect model to eliminate the endogenous from health insurance policy.

2.2. Variables

The alcohol consumption (AC) has been split into the frequency and amount of alcohol beverage in the questionnaire, such as "Do you drink this type (Beer, Grape wine, Liquor) of alcohol?", and "How much do you drink (Beer: Bottle, Grape wine: 50 g, Liquor: 50 g) each week?".

We used these questions to calculate individual daily alcohol consumption (gram) as our explained variable. Whether the individual is insured is our explanatory variable. The moderator was asked "Has a doctor ever told you that you suffer from diabetes?". Control variables includes individual gross income, household gross income, body mass index (BMI), working status, education, age, gender, and primary occupation. Considering that there are large differences in income in China, in order to make the distribution of income more symmetrical and reduce the impact of extreme values, we calculated the logarithm transformation of individual gross income and household gross income. Due to the existence of 0 in individual gross income, we calculated it as $\log(1 + \text{individual gross income})$.

2.3. Model

The empirical strategy to estimate whether the diabetics insured consume more alcohol could be represented by the difference between the population diagnosed with diabetics and the population diagnosed without diabetics. Therefore, the interaction between *HI* and *Diabetes* is estimated. The base estimation which only included *HI* and *Diabetes*, without their interaction, shows the effect of health insurance and the diagnosis of diabetes.

$$AC_{it} = \alpha + \beta HI_{it} + \delta Diabetes_{it} + X\gamma + u_i + T_t + \varepsilon_{it} \quad (1)$$

$$AC_{it} = \alpha + \beta HI_{it} + \delta Diabetes_{it} + \zeta HI_{it} * Diabetes_{it} + X\gamma + u_i + T_t + \varepsilon_{it} \quad (2)$$

where AC_{it} is daily alcoholic drinking of individual i in year t ; HI_{it} is whether individual i insured in year t , took the value of 1 if has been insured; $Diabetes_{it}$ shows whether individual i has been diagnosed with diabetes in year t , took the value of 1 if has been diagnosed. X is the vector of control variables, which contains individual's income, household gross income, BMI, education, age, working status, and primary occupation; u_i is individual fixed effect; T_t is year fixed effect; ε_{it} is the error term.

The interaction term could be interpreted as the difference and significance between the insured diagnosed with diabetes and not. Therefore, the coefficient of interaction showed that the difference of alcohol consumption between the individual diagnosed with diabetes and not when his medical costs was covered by health insurance. Specifically, β showed the effect of health insurance, which helped us further infer the difference of effect among different crowds with health insurance policy. ζ showed the marginal effect of ex-ante moral hazard for insured.

3. Results

3.1. Summary Statistics

After removing missing values and invalid values, the balance panel data contains 2255 individuals and 6765 observations.

As shown in Table 1, the individuals participating survey averagely consume 10.22 g of alcohol, but the distribution varies a lot. 92% individuals have health insurance. There

are about 31% individuals living in urban. About 4% of individuals are diabetics that is half lower than the estimation of prevalence of diabetes in China from 2009 to 2015.

Table 1. Summary statistics of the variables.

Variable Name	N	Mean	SD	Min	Median	Max
alcohol consumption	6765	10.22	27.491	0	0	336.43
Health insurance (HI)	6765	0.92	0.28	0	0	1
Diabetes	6765	0.04	0.190	0	0	1
Gender	6765	0.48	0.500	0	0	1
Individual gross income	6765	21,887.07	34,634.43	0	15,958.82	1,099,989
log(1 + Individual gross income)	6765	9.49	1.153	0	9.68	13.91
Household gross income	6765	57,354.56	75,081.85	400	41,770	1,458,000
log(Household gross income)	6765	10.58	0.876	5.99	10.64	14.19
BMI	6765	23.76	3.314	15.22	23.62	34.98
Education	6765	1.93	1.477	0	2	6
Working Status	6765	0.65	0.477	0	1	1
Age	6765	54.40	12.120	19	55	92
Urban	6765	0.31	0.463	0	0	1

As shown in Table 1, 52% observations were females; 65% observations were still working; the average BMI among observations was 23.76; the average age among observations was 54.40.

3.2. Empirical Results

Table 2 reported the main results from estimation, two models have been estimated as mentioned before. Based on the identification in column (1), those who have been insured reduced their alcohol consumption by 3.595 g per day. In column (2), the difference between insured individuals between diabetic and non-diabetic has been estimated, the coefficient showed that the two groups have an 8.184 g difference per day in alcohol consumption, and the diabetics consumed more. All stand errors estimated were robust standard error to avoid the bias from heteroscedasticity.

Table 2. Two-way fixed effect and Moderator effect.

	Baseline	Moderating Effect
HI	−3.595 *** (1.050)	−3.973 *** (1.093)
Diabetes	3.263 (2.598)	−4.162 * (2.366)
HI:Diabetes		8.184 *** (2.199)
Education	0.214 (0.575)	0.213 (0.575)
Working Status	−2.021 (1.690)	−2.067 (1.745)
Age	−0.367 *** (0.076)	−0.366 *** (0.076)
BMI	0.728 *** (0.219)	0.731 *** (0.219)
log(1 + Household gross income)	0.176 (0.521)	0.174 (0.520)
log(1 + Individual gross income)	0.098 (0.342)	0.097 (0.342)
Wave:2011	0.178 (0.517)	0.174 (0.517)

Table 2. *Cont.*

	Baseline	Moderating Effect
Wave:2015	−2.359 *** (0.739)	−2.370 *** (0.739)
Intercept	6.371 (6.675)	6.628 (6.674)
Fixed effect	Control	Control
N	6765	6765
Adjusted R ²	0.42	0.42

Note: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively. The values in parentheses are the robust standard errors.

Therefore, the conclusion can be led that health insurance reduced alcohol consumption, but the insured diabetics would increase their alcohol consumption. The difference between insured diabetics and insured non-diabetics was 8.184.

3.3. Robustness Test

To identify whether the effects were reliable, that whether health insurance reduced alcohol consumption among the population and the difference between diabetics and non-diabetics, we performed two robustness tests: log transformation and fixed effect panel logit model using jackknife estimator.

3.3.1. Log Transformation

One may be concerned that only a few participants who drink a lot influenced the estimation, which could be observed in Table 1, and the efficiency of estimation would be violated. To avoid this criticism, a log transformation on daily alcohol consumption was performed. However, a lot of observations averagely consumed 0 g per day, to make a valid transformation, the log transformation was performed by $\log(1 + \text{alcohol consumption})$. Although the estimation could not be directly inferred as a semi-elasticity, the result would still be similar. So, the coefficients estimated were inferred as semi-elasticity for brevity.

Table 3 reported results from estimation.

Table 3. Robust test: log transformation.

	Baseline	Moderating Effect
HI	−0.130 *** (0.046)	−0.150 *** (0.048)
Diabetes	0.013 (0.092)	−0.386 ** (0.154)
HI:Diabetes		0.440 *** (0.153)
Education	−0.016 (0.023)	−0.016 (0.023)
Working Status	−0.285 * (0.169)	−0.287 * (0.171)
Age	−0.015 (0.019)	−0.015 (0.019)
BMI	0.025 *** (0.009)	0.025 *** (0.009)
$\log(1 + \text{Household gross income})$	0.031 (0.021)	0.031 (0.021)
$\log(1 + \text{Individual gross income})$	0.009 (0.015)	0.009 (0.015)
Wave:2011	0.027 (0.044)	0.027 (0.044)

Table 3. Cont.

	Baseline	Moderating Effect
Wave:2015	−0.215 * (0.115)	−0.215 * (0.115)
Intercept	0.777 (0.613)	0.791 (0.613)
Fixed effect	Control	Control
N	6765	6765
Adjusted R ²	0.62	0.62

Note: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively. The values in parentheses are the robust standard errors.

$\log(1 + \text{Household gross income})$ $\log(1 + \text{Individual gross income})$ Based on the identification, the direction of coefficients were same as the estimation in Table 2. The robustness test of log transformation also provided the practical significance [15]. The semi-elasticity analysis showed that health insurance reduced 13% alcohol consumption per day. The difference between diabetics and non-diabetics was 44%, and the diabetics consumed more.

3.3.2. Logit Fixed Effect Model

Although every drop of alcohol can cause damage to the body [16], countries still have different dietary guidelines. The medical staff may be affected by dietary guidelines, and a moderation drinking order would be given to patients. Therefore, to estimate whether the alcohol consumption was moderate or not, a logit fixed effect model was implemented. To implement it, we define an index, which is assigned as 1 when individuals consume alcohol above a boundary. Following Chinese Dietary Guidelines, the harmful drinking boundary is 25 g for males and 15 g for females.

Table 4 showed the estimation of Logit fixed effect model. The odds ratio of health insurance converted from column (1) was about 0.63, that convinced us that, in the general population, health insurance is a protective factor. The odds ratio of the interaction term was about 3.48, that also showed the difference between diabetics and non-diabetics.

Table 4. Robust test: Logit fixed effect model.

	Baseline	Moderating Effect
HI	−0.494 * (0.088)	−0.540 * (1.78)
Diabetes	0.485 (0.443)	−3.266 ** (2.07)
HI:Diabetes		3.568 ** (2.31)
Education	0.081 (0.61)	0.091 (0.68)
Working Status	45.852 (0.03)	45.833 (0.03)
Age	0.155 *** (3.36)	0.150 *** (3.24)
BMI	0.102 * (1.78)	0.103 * (1.79)
$\log(1 + \text{Household gross income})$	0.266 * (1.95)	0.262 * (1.91)
$\log(1 + \text{Individual gross income})$	−0.346 *** (3.66)	−0.343 *** (3.63)
Wave:2011	−0.098 (0.58)	−0.075 (0.44)
Wave:2015	−2.097 *** (6.52)	−2.066 *** (6.43)

Table 4. Cont.

	Baseline	Moderating Effect
Fixed effect	Control	Control
N	1539	1539
Pseudo R ²	0.17	0.19

Note: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively. The values in parentheses are the jackknife standard errors.

3.4. Heterogeneity Analysis

Two heterogeneity estimations were implemented in this section. The first one was whether there existed heterogeneity between young and old groups. The reason to implement this estimation was to take the trend of aging around the world. If heterogeneity existed, the strategies of diabetes management should be tailored. To perform this analysis, the boundary of old should be set, this paper adopted the retirement age stipulated by the Chinese labor law, which is 60 years old. The second one was whether there existed heterogeneity between urban and rural groups. The reasons to implement this estimation has two: (1) In the process of China's urbanization, more elderly individuals and individuals with lower education level have been left in the rural, and their cognition and behavior of diseases will be different from the urban population. (2) There were differences in policies between urban health insurance and rural health insurance (NCMS) in China, and the difference occurred with the inequality of medical resources.

3.4.1. Old vs. Young

Column (1) and column (2) of Table 5 reported the difference between old and young. The coefficients we interested showed that the young group behave riskier than the *HI* and *Diabetes* were not significant, and the interaction term was much higher than old group. The control variables reminded that the different income composition also affected the behavior.

Table 5. Heterogeneity Analysis.

	Old vs. Young		Rural vs. Urban	
	Old	Young	Rural	Urban
HI	−5.620 *** (1.574)	−1.894 (1.509)	−6.327 *** (1.792)	−1.958 (1.336)
Diabetes	−7.782 *** (2.446)	−1.526 (3.683)	−3.705 (4.158)	−4.992 * (2.638)
HI:Diabetes	6.539 *** (2.235)	10.591 *** (3.940)	11.048 *** (4.114)	5.134 ** (2.567)
Education	−0.798 (0.796)	0.319 (0.776)	0.464 (0.821)	−0.196 (0.699)
Working Status	−5.503 (3.508)	−0.503 (2.788)	−4.393 ** (2.184)	1.747 (3.041)
Age	0.333 ** (0.162)	−0.556 *** (0.101)	0.621 ** (0.263)	−0.330 *** (0.092)
BMI	0.237 (0.269)	1.043 *** (0.290)	0.665 ** (0.283)	0.913 *** (0.304)
log(1 + Household gross income)	2.573 *** (0.939)	−0.738 (0.695)	0.006 (0.592)	0.930 (1.051)
log(1 + Individual gross income)	−0.536 (0.555)	0.854 ** (0.427)	0.051 (0.371)	0.834 (0.880)
Wave:2011	0.910 (0.961)	−0.654 (0.625)	−1.282 (0.815)	−0.982 (0.779)
Wave:2015	−4.427 *** (1.320)	−2.624 ** (1.062)	−7.934 *** (1.733)	−4.064 *** (1.153)

Table 5. Cont.

	Old vs. Young		Rural vs. Urban	
	Old	Young	Rural	Urban
Intercept	−37.936 ** (16.812)	12.963 (9.447)	−2.234 (8.124)	−14.684 (13.508)
Fixed effect	Control	Control	Control	Control
N	2385	4380	4665	2100
Adjusted R ²	0.40	0.46	0.42	0.39

Note: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively. The values in parentheses are the robust standard errors.

3.4.2. Rural vs. Urban

Column (3) and column (4) of Table 5, reported the difference between rural and urban. The difference of significance between rural and urban showed the effect of initiative, because the health insurance in urban group was compulsory policy, and the urban individual was insured when the employer of the individual paid the wages, which performed like tax. This can also explain that the *Diabetes* is significant in urban groups but not in rural groups. For both urban and rural groups, however, people with diabetes who had health insurance would consume more alcohol.

4. Discussion

In this study, we have identified whether health insurance reduced alcohol consumption, which is wildly debated. The ex-ante moral hazard of diabetics has been focused on due to the feature of diabetes that diabetes is manageable, and self-protection prevents severe complications. The effect on the whole population and the difference between diabetics and non-diabetics provided guidance for public health policy formulation in the context of aging and urbanization. The effect of health insurance and the difference between the two groups also provided a perspective on ex-ante moral hazard which asserted that the insured would behave in risky behavior, i.e., consuming more alcohol. Compared with previous studies, this paper reconciles the contradiction of the influence of health insurance on behaviors by analyzing the drinking behavior of diabetic insured. The result was robust, supported by log transformation and fixed logit model estimation.

Our results showed that health insurance would reduce not only alcohol consumption, but also excessive drinking. But the effect of health insurance has heterogeneity. The difference between old and young groups could be explained in two ways: (1) the medical-seeking in two groups were different, old groups usually consume more medical resources and get more orders from medical staff; (2) the risky utility between old and young groups is different, the death anxiety of old group was higher than young [17]. The difference in health insurance system between rural and urban groups, the rural health insurance system was compulsory, which decreased the perception of healthy. However, NCMS was voluntary. The local government has an annual target for increasing the participation rate of NCMS. Therefore, the local government usually would hold pep rallies, and the insured had more perception compared with urban groups.

The difference in alcohol consumption between diabetics insured and non-diabetics insured was significant in practical significance and statistical significance among all estimations, regardless of the population. Lifestyle played an important role in diabetes management that would reduce substantial risk [18], and advice from doctors was usually the same for patients that smoke less, and drink less. But our results conflict with the prediction from the base model that diabetics would obey advice. This result may be closely related to the features of diabetes that early diabetic patients have limited awareness of the damage of diabetes, and they believed that the health loss caused by their drinking behavior would be compensated by health insurance [4].

Thus, the sustainability of health care in the face of aging and rising diabetes prevalence would become a central issue for public health. It can even be further inferred those

manageable chronic diseases with low susceptibility and severity would further threaten the sustainability of health insurance. Although not directly analyzed in this study, the heterogeneity between old and young groups could infer the importance of knowledge in avoiding risk behaviors.

Therefore, from the macro perspective, to maintain the sustainability of health insurance and the well-being of public health, how to effectively promote patients to live a healthy lifestyle should be focused on sustainable topic. The Merit-based Incentive Payment System (MIPS) in United States could be an example for developing a public health system with prevention as a key element. In MIPS, about 15% of performance measurement were about improvement activities including beneficiary engagement, care coordination, behavioral and mental health, etc. [19]. However, the long-term effects of MIPS still maintain in mist. From the micro perspective, under the trend of aging, the management of chronic diseases requires the participation of medical staff to improve the patient's perceived susceptibility, severity, and benefit [20]. Especially for the patients in rural areas, the participation of medical staff is necessary to improve their health belief, and health equity.

In summary, the insured ex-ante moral hazard was estimated in this study, the difference between diabetics and non-diabetics showed the ex-ante moral hazard existed in diabetics, but health insurance itself would reduce alcohol consumption. The results suggested the role of preventive medicine and behavioral medicine in health insurance sustainability in the age of aging and chronic disease prevalence.

5. Limitation

Although our results indicate that health insurance reduces alcohol consumption, we remained the mist of micro-mechanism of behaviors. Thus, future research could focus on exploring the path of behavior decision under health belief model, and the intervention to develop patients' healthy lifestyle.

The major limitation of the present study is the usage of diabetes. Diabetes is a manageable chronic disease and serious complications can be avoided with effective health management. This feature may limit the generalizability of the results of this study when compared to other chronic diseases, such as cancer. Due to data limitations, this paper cannot further differentiate type 1 diabetes from type 2 diabetes. However, due to the difference in prevalence, the bias caused by this limitation could be ignored.

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