Tobacco Use, Health Care Utilization, Household Expenditure and Smoking Cessation
in China

Mr. Changle Li

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วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาเศรษฐศาสตรดุษฎีบัณฑิต
สาขาวิชาเศรษฐศาสตร์
คณะเศรษฐศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2560
ลิขสิทธิ์ของจุฬาลงกรณ์มหาวิทยาลัย

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By	Mr. Changle Li
Field of Study	Economics
Thesis Advisor	Professor Siripen Supakankunti, Ph.D.

Accepted by the Faculty of Economics, Chulalongkorn University in Partial Fulfillment of the Requirements for the Doctoral Degree

⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯Dean of the Faculty of Economics

(Professor Worawet Suwanrada, Ph.D.)

THESIS COMMITTEE

⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯Chairman

(Associate Professor Pongsa Pornchaiwiseskul, Ph.D.)

⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯Thesis Advisor

(Professor Siripen Supakankunti, Ph.D.)

⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯Examiner

(Assistant Professor Chantal Herberholz, Ph.D.)

⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯Examiner

(Assistant Professor Nopphol Witvorapong, Ph.D.)

⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯External Examiner

(Associate Professor Sauwakon Ratanawijitrasin, Ph.D.)

ฉางเล่อ ลี : การบริโภคยาสูบ การใช้บริการสาธารณสุข การใช้จ่ายภาคครัวเรือน และการเลิกบุหรี่ใน ประเทศจีน (Tobacco Use, Health Care Utilization, Household Expenditure and Smoking Cessation in China) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ศ. ดร.ศิริเพ็ญ ศุภกาญจนกันติ, 188 หน้า.

วิทยานิพนธ์เล่มนี้ได้ศึกษาผลกระทบจากการบริโภคยาสูบที่มีต่อการใช้บริการสาธารณสุข การใช้จ่าย ของครัวเรือน และการประเมินสุขภาพของตนเองของผู้ที่อาศัยอยู่ในเขตชนบทของสาธารณรัฐประชาชนจีน ข้อมูลที่ ใช้ในการศึกษาประกอบด้วยข้อมูลในช่วงปี พ.ศ. 2553 ถึง พ.ศ. 2557 จาก China Family Panel Studies data สำหรับการศึกษาต้นทุน-ประสิทธิผลของโครงการการให้บริการการเลิกสูบบุหรี่นั้น การศึกษานี้ได้ใช้รูปแบบการ ทดลองแบบสุ่มและมีกลุ่มควบคุม จากข้อมูลจากการทดลองนี้ได้ทำการวิเคราะห์ต้นทุน-ประสิทธิผลของการ ให้บริการการเลิกสูบบุหรี่แก่ผู้สูบในช่วงอายุระดับอุดมศึกษาในพื้นที่เขตปกครองตนเองมองโกเลีย ของสาธารณรัฐ ประชาชนจีน

ผลการศึกษาพบว่า กลุ่มตัวอย่างในเขตพื้นที่ชนบทของสาธารณรัฐประชาชนจีนมีลักษณะที่พบดังนี้ (1) ทั้งผู้ที่สูบบุหรี่ในปัจจุบันและผู้ที่เคยสูบบุหรี่โดยในปัจจุบันได้เลิกสูบบุหรี่แล้วได้เข้าใช้บริการเป็นผู้ป่วยนอกของ สถานพยาบาลและโรงพยาบาลมากกว่าผู้ที่ไม่สูบบุหรี่ และผู้ที่เคยสูบบุหรี่มีการใช้บริการในการรักษาในฐานะผู้ป่วย ในมากกว่าผู้ที่ไม่สูบบุหรี่ (2) ผู้ที่เลิกสูบบุหรี่ได้ในระยะยาวมีโอกาสในการใช้บริการในฐานะผู้ป่วยในลดลงเมื่อ เปรียบเทียบกับผู้ที่เพิ่งเลิกสูบบุหรี่ได้ไม่นานหรือผู้ที่เลิกสูบบุหรี่ได้เพียงระยะหนึ่ง (3) ผู้ที่เลิกสูบบุหรี่ไม่นานและผู้ที่ สามารถเลิกสูบบุหรี่ได้เป็นระยะเวลานานแล้วมีโอกาสสูงกว่าในการเข้าพบแพทย์และทำการรักษาพยาบาลใน โรงพยาบาลทั่วไปและโรงพยาบาลซึ่งมีความเชี่ยวชาญในการรักษาเฉพาะโรคเมื่อเปรียบเทียบกับการเข้ารับการรักษาใน ศูนย์สุขภาพระดับหมู่บ้านและคลินิก (4) การบริโภคยาสูบส่งผลให้ครัวเรือนลดค่าใช้จ่ายด้านอาหาร เครื่องแต่งกาย การดูแลสุขภาพ และด้านการศึกษา ยิ่งไปกว่านั้น ครัวเรือนที่มีการบริโภคยาสูบในปริมาณมากได้ลดค่าใช้จ่าย จำนวนมากเกี่ยวกับการดูแลรักษาสุขภาพและรายจ่ายด้านการศึกษาเมื่อเปรียบเทียบกับครัวเรือนที่บริโภคยาสูบใน ปริมาณน้อยหรือไม่บริโภคยาสูบเลย (5) ผู้ที่ไม่สูบบุหรี่หรือเลิกบุหรี่แล้วมีแนวโน้มที่จะประเมินด้วยตนเองว่ามี สุขภาพที่ดีขึ้นเมื่อเทียบกับปีที่ผ่านมา ทั้งนี้ การที่บุคคลที่สามารถเลิกสูบบุหรี่มีแนวโน้มการประเมินด้วยตนเองว่ามี สุขภาพที่ดีขึ้นนั้นพิสูจน์ให้เห็นว่าผลลัพธ์จากการเลิกสูบบุหรี่สามารถช่วยให้ระดับสุขภาพจากการประเมินตนเองดี ขึ้น (6) การรักษาแบบ การเตือนด้วยข้อความทางโทรศัพท์มือถือและการบำบัดแบบกลุ่ม (mobile phone text messaging plus group behavior therapy) มีต้นทุนประสิทธิผลมากกว่าวิธีการรักษาโดยการใช้นิโคตินทดแทน (nicotine replacement therapy) ในระยะเวลา 3 เดือนโดยใช้อัตราการเลิกบุหรี่ได้อย่างต่อเนื่องเป็นการวัด ประสิทธิผล ของกลุ่มผู้สูบบุหรี่ที่เป็นนักศึกษาระดับอุดมศึกษาในเขตปกครองตนเองมองโกเลีย สาธารณรัฐ ประชาชนจีน

สาขาวิชา	เศรษฐศาสตร์	ลายมือชื่อนิสิต ....
ปีการศึกษา	2560	ลายมือชื่อ อ.ที่ปรึกษาหลัก ....

5685902029 : MAJOR ECONOMICS

CHANGLE LI: Tobacco Use, Health Care Utilization, Household Expenditure and Smoking Cessation in China. ADVISOR: PROF. SIRIPEN SUPAKANKUNTI, Ph.D., 188 pp.

This dissertation studied the tobacco use impact of on health care utilization, household expenditure, and self-rated health among rural residents in rural China. The 2010-2014 China Family Panel Studies data were employed here. Moreover, this study also conducted the randomized controlled trial and analyzed the cost-effectiveness smoking cessation intervention among college-aged smokers in Inner Mongolia, China.

The main findings showed: (1) Current and former smokers use more outpatient care than non-smokers. Moreover, former smokers use more inpatient care than non-smokers in rural China. (2) Long-term quitters decreased the probability of using inpatient care compared with recent and moderate-term quitters in rural China. (3) Recent and long-term quitters had a much higher probability of visiting the general and specialized hospital compared to vising the village health center and the clinic in rural China. (4) Tobacco consumption crowded out expenditures on food, dress, health care, and education for rural households in China. Moreover, high tobacco consumption households reduced much more spending on health care and education compared with other tobacco consumption households in rural China. (5) Non-smokers and ex-smokers were more likely to report their health status as better compared with last year. Additionally, Ex-smokers were more likely to report better health compared with last year in rural China and proves that the result of quitting may improve self-report health status. (6) TM plus GBT was more cost-effective compared to the NRT at 3 months based on the continuous abstinence rate as effectiveness measurement among college-aged adult smoker in Inner Mongolia, China.

Field of Study: Economics	Student's Signature
Academic Year: 2017	Advisor's Signature

ACKNOWLEDGEMENTS

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Introduction

1.1 Backgrounds

1.1.1 Tobacco Epidemic in China

Globally, China is the largest tobacco consumer in the world. There are more than 300 million smokers in China, nearly one-third of the world's total (World Health Organization, 2014). Table 1.1 shows that 27.7 % of Chinese adults were current smokers in 2015. The smoking prevalence rate of Chinese adults has been stable compared to the rate (27.4%) in 2010. However, with the growth of the China's population between 2010 and 2015, the number of current smokers increased by 15 million. The average number of cigarettes smoked per day was 15.2 in 2015, namely China's current smokers consumed 44% of world's cigarettes.

More than half of adult males were current smokers, but only less than 3% of adult females were current smokers in 2015. For men, the prevalence was the highest among those 45 to 64 years of age (60.0%) and lowest among those 15 to 24 years of age (36.5%). The prevalence of smoking among men was significantly higher among rural residents (55.4%) as compared with inhabitants of urban areas (49.0%).

Table 1.1 Smoking Prevalence Rates of Chinese Adults in 2015

Demographic characteristic	All adults	Men	Women
	Percent (95% confidence interval)		
Overall	27.7 (25.9-29.6)	52.1 (49.4-54.8)	2.7 (2.1-3.6)
Age			
15-24	18.9 (15.1-23.4)	36.5 (30.1-43.5)	0.5 (0.2-1.7)
25-44	29.5 (26.8-32.5)	56.2 (51.3-61.0)	1.9 (1.2-3.0)
45-64	32.4 (30.5-34.3)	60.0 (57.2-62.7)	3.8 (2.8-5.2)
>=65	25.1 (22.8-27.6)	44.9 (40.9-48.8)	6.9 (5.1-9.2)
Residence			
Urban	26.1 (23.3-29.1)	49.0 (45.0-53.0)	2.7 (1.8-3.9)
Rural	29.4 (27.2-31.6)	55.4 (51.8-58.9)	2.8 (1.9-4.2)
Education level			
Primary school or less	25.9 (22.9-29.2)	59.4 (55.2-63.4)	4.8 (3.5-6.7)

Attended secondary school	36.5 (34.1-38.9)	61.3 (57.6-64.8)	3.2 (2.0-5.2)
High-school graduate	31.5 (28.0-35.1)	54.6 (49.4-59.7)	1.3 (0.7-2.7)
College graduate or above	23.5 (18.7-29.1)	41.9 (33.6-50.7)	0.9 (0.3-2.7)
Region			
East	25.4 (22.6-28.5)	49.1 (44.6-53.5)	2.3 (1.4-3.6)
Central	28.3 (24.7-32.3)	54.3 (49.2-59.2)	3.9 (2.6-6.0)
West	30.0 (27.6-32.6)	54.2 (49.9-58.5)	2.5 (1.4-4.3)

Source: Chinese Center for Disease Control and Prevention, 2016

In the meantime, China is the world's largest producer of tobacco. All cigarettes are produced by state-owned tobacco enterprises, or China National Tobacco Corporation. It is the largest tobacco company in the world and produces approximately 2.5 trillion cigarettes each year. About the 7.0% of China's central government revenue, or $170 billion is generated from tobacco profits and taxes (World Health Organization, 2017).

1.1.2 Impact of Tobacco Use on Health

Tobacco use is a risk factor for cancer, heart disease, and other diseases, and it causes 24.9% of male and 12.8% of female deaths in China (The Tobacco Atlas, 2017). More details are as follows:

1.1.2.1 Cancer

Tobacco use is a carcinogen, and it causes lung cancer, oral and pharyngeal cancer, esophageal cancer, laryngeal cancer, pancreatic cancer, stomach cancer, liver cancer, kidney cancer, cervical cancer, and bladder cancer.

Tobacco use causes nearly 80% of male and 50% of female lung cancer deaths, and 70% of lung cancer deaths overall in the world. In 2008, the registered lung cancer mortality rate increased by 464.84% in the past 3 decades in China (She et al., 2013).

1.1.2.2 Cardiovascular Disease

Tobacco use could cause cardiovascular and cerebrovascular diseases, such as heart attack, stroke, and coronary and peripheral artery disease.

In China, aged 30-44 years' men who die from cardiovascular disease, 46% of these deaths are attributable to tobacco. Moreover, smoking is estimated to cause 10% of cardiovascular disease worldwide (World Health Organization, 2014).

1.1.2.3 Other Diseases and Health Risks

Tobacco use may cause complications for patients with Type 2 diabetes, and it independently associated with the risk of diabetes among men, the odds ratio being 1.7 (Ko, et al., 2001).

Tobacco use also increases the risk of some communicable diseases, such as tuberculosis (TB), legionnaires disease, and pneumococcal pneumonia. Smoking is responsible for approximately 20% of global TB incidence (World Health Organization, 2014).

Tobacco use while pregnant harms the foetus, leading to low birth weight and other health problems for both the mother and baby, and may increase the risk of Sudden Infant Death Syndrome (World Health Organization, 2014).

1.1.3 Tobacco Use and Welfare

Tobacco use impoverishes people already on very low incomes and makes them difficult to escape poverty traps, so the gap between the rich and the poor is widening. Firstly, tobacco use is a risk behavior, and the costs of treating smoking-related diseases cannot afford by poor households, particularly in the absence of medical insurance that covers the full cost of treatment. Secondly, tobacco use is an expensive addiction, and spending on tobacco in low-income households diverts budgets from necessities, such as food, education, health care, and dress. Lastly, the premature death of a primary income earner from smoking-related diseases can cause a household to lose its major source of income.

In 2016, there are 56 million people who live in rural poverty (World Health Organization, 2017). The impact of tobacco use on welfare is especially profound in China.

1.1.4 Impact of Tobacco Use on Health Care System

Tobacco use causes a lot of chronic diseases that affect the health care system, such as heart disease, various cancers, and respiratory diseases. First, the health hazards of tobacco use lead smokers to consume more medical resources than non-smokers (Izumi et al., 2001), so the health delivery system bear these burden. Second, the total economic cost of tobacco use in China was about $ 57 billion in 2014 (World Health Organization, 2017). These costs increase a proportion of the government's significant additional investment in health, and the health insurance system will bear an increasing share of these costs as China moves toward universal health coverage scheme.

1.1.5 Smoking Cessation Policy in China

China ratified the World Health Organization Framework Convention on Tobacco Control (FCTC) in 2005 and made advances, but compared to the FCTC requirements there are still significant gaps that represent packaging of cigarettes and taxes on tobacco products (Li et al., 2016). The main reason is that the economic benefits of the tobacco industry (about 7.0% of state revenue), and Chinese policymakers are averse to implement much stricter tobacco control to protect non-smokers (Li et al., 2016; Hu et al., 2013).

1.1.5.1 Protection from Second-hand Smoke

Noteworthy, on November 2014, Beijing, or China's capital passed the strictest smoking control law and implemented on 1 June 2015. The law requires all indoor public and working places to be 100% smoke free. Other cities are following the Beijing, for example, Shanghai adopted a strong smoke free law that implemented in March

2017. On 1 January 2017, Shenzhen also requested all indoor public places to be 100% smoke free (World Health Organization, 2017; Yang et al., 2015).

1.1.5.2 Tobacco Taxation

The 40% to 46% of retail price is excise tax in 2011, which is very low compared to the FCTC recommendation of 70% (Yang et al., 2015). In May 2015, the Ministry of Finance implemented an increase in tobacco taxation. With the increase of tax, about the 55% of retail price is excise tax.

1.1.5.3 Tobacco Package Warning Label

A plain, standardized pack with a large health warning of tobacco products is the best practice. However, the warning labels on Chinese tobacco products are not large (about 35%), clear, visible, and graphic (The Tobacco Atlas, 2017).

1.1.5.4 Tobacco Advertising

On 1 September 2015, the National Advertising Law started taking into effect. The law bans tobacco advertising in public transport, public places, and mass media. However, the law does not enforce the tobacco advertising at retail point of sale (World Health Organization, 2017; Yang et al., 2015).

1.1.5.5 Smoking Cessation Services

In 1996, the first smoking cessation clinic was set up in the Beijing Chao-Yang Hospital of Capital Medical University. Until now, more than 800 smoking cessation clinics have been established in different provinces China, but half of the smoking cessation clinics open are operated by the respiratory department in each hospital. The quit-line and brief intervention are offered by the smoking cessation clinics, and only 26 smoking cessation clinics provide pharmacotherapies (Wang, 2015). The operation performance of smoking cessation clinics is poor, and 1-2 smokers per week

seek help in each smoking cessation clinic (Yang et al., 2015). One of the possible reasons why low attendance is that smoking cessation services are not covered by medical insurances.

1.1.5 Health Care System in China

The People's Republic of China also called China. China is the most populous state in the world, with approximately 1.38 billion citizens (see Table 1.2-1.3). Located in East Asia, the country covers about 9.6 million square kilometers. It is the world's second-largest country by land area. It exercises jurisdiction 23 provinces, 5 autonomous regions, 4 directly controlled municipalities (Beijing, Tianjin, Shanghai, and Chongqing), and 2 special administrative regions (Hong Kong and Macau). Its capital city is Beijing. For the autonomous regions, they are each with designated minority group: Inner Mongolia Autonomous Region, Guangxi Autonomous Region, Ningxia Autonomous Region, Xinjiang Uighur Autonomous Region, and Tibet Autonomous Region are inhabited by Mongolians, Zhuang people, Hui people, Uighurs, and Tibetans, respectively.

According to the World Health Organization statistics, the Chinese life expectancy at birth was 76 years (75 years for males and 78 years for females) in 2016.

Table 1.2 Age Composition of China (10000 persons)

Year	Total Population	By Age					
		Aged 0-14		Aged 15-64		Aged 65 and over	
		Population	Proportion	Population	Proportion	Population	Proportion
2016	138271	23008	16.64	100260	72.51	15003	10.85

Source: National Bureau of Statistics of China, 2017

Table 1.3 Gender Composition of China (10000 persons)

Year	Total Population	By Sex			
		Male		Female	
		Population	Proportion	Population	Proportion
2016	138271	70815	51.21	67456	48.79

Source: National Bureau of Statistics of China, 2017

China is the world's second-largest economy and its nominal GDP was US $11.20 trillion in 2016. However, China's 2014 nominal GNI per capita was US $8,250 (World Bank, 2017).

1.1.5.1Health Care Financing

1 National Health Account

Table 1.4 shows the China's National Health Account from 2013 to 2016. The expenditure on health (THE) as % of GDP increases from 5.4% in 2013 to 6.3% in 2016. In 2016, the social expenditure on health as % of THE is much higher than the general government expenditure on health as % of THE, and the rates are 41.2% and 30.0%, respectively. The private expenditure on health as % of THE is the lowest rate that was 28.2%.

Table 1.4 China's National Health Account

	2013	2014	2015	2016
Total expenditure on health (THE) as % of GDP	5.4	5.5	6.0	6.3
General government expenditure on health as % of THE	30.1	30.0	30.4	30.0
Social expenditure on health as % of THE	36.0	38.1	40.3	41.2
Private expenditure on health as % of THE	33.9	31.9	29.3	28.2

Source: National Bureau of Statistics of China, 2017

2 Basic Healthcare Insurance System

There are mainly two types of basic medical insurance schemes in China, which are Basic Medical Insurance for Urban Employees (BMIUE) and Basic Medical Insurance for Urban and Rural Residents (BMIURR), respectively.

(1) BMIUE

The BMIUE is for urban workers and was established by the Chinese State Council at the end of 1998. The BMIUE consists of a pooled fund for inpatient stays and outpatient visits. It is financed by payroll taxes paid by employers (6%) and employees (2%). In 2016, about 295.32 million people (approximately 21% of total population) were covered by the BMIUE (National Bureau of Statistics of China, 2017).

(2) BMIURR

New Rural Cooperative Medical Scheme (NRCMS) and Basic Medical Insurance for Urban Residents (BMIUR) have been merged into the BMIURR in 2016. The BMIURR is for rural residents and urban unemployed residents, and receives funding from central government, local government and individuals. The BMIURR becomes the largest medical insurance scheme in China and covers more than one billion people (More than 70% of total population). Base on the demand of health care, the provincial governments are asked to establish their own essential drug list and benefit package of the BMIURR.

1.1.5.1 Health Services Delivery System

In China, health services are mainly provided by governmental hospitals. In 2016, there were 29,140 hospitals in China (National Bureau of Statistics of China, 2017). The 90% of total hospitals are public hospitals that are under the Ministry of Health, the provincial health department, or the municipal health department, and the rest 10% are private hospitals (Frost and Sullivan, 2011). In 2016, there were 2.3 doctors per 1000 persons and 2.5 nurses per 1000 persons, respectively (National Bureau of Statistics of China, 2017).

Popularly, governmental hospitals include public hospitals, military hospitals, teaching hospitals, and corporate hospitals (See Figure 1.1). In addition, the Ministry of Health divides governmental hospitals into three different tiers. The tier 1 is the lowest tier. The standard criteria of classifying are in term of facilities, medical technology, hospital administration, and hospital quality.

Figure 1.1 China's Hospital System
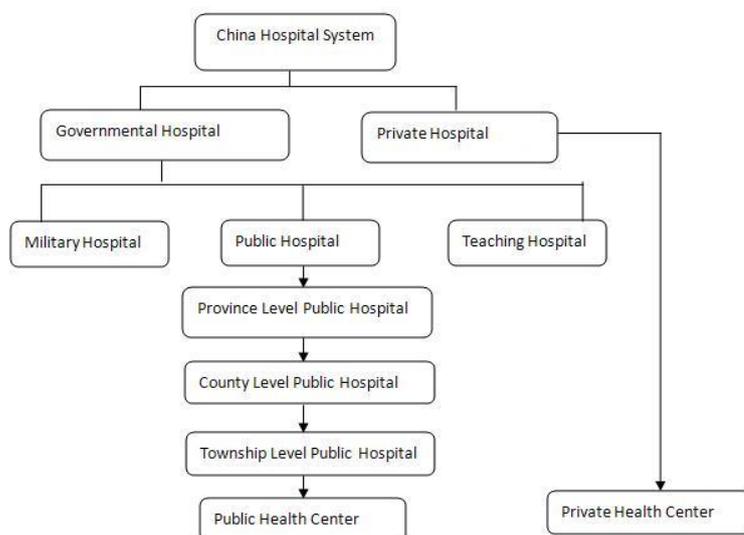
Source: Author

The Ministry of Health published a national essential drug list in August 2009, which marked the beginning of establishing the National Essential Drug System (NEDS). The NEDS aims to lower the price by reducing the middleman, and setting ceiling price for drugs. According to the NEDS, the provincial government is responsible for holding public bidding, purchasing, and delivering drugs to hospitals directly (Frost and Sullivan, 2011).

1.2 Research Questions

1.2.1 How smoking affects health care utilization among rural residents in China?

1.2.2 What is the choice of health facility among current and former smokers in rural China?

1.2.3 How tobacco consumption affects household expenditure on other goods and services in rural China?

1.2.4 What is the impact of tobacco consumption to self-rated health among rural household members in China?

1.2.5 Which is the most cost-effective smoking cessation intervention between nicotine replacement therapy (NRT) and mobile phone text messaging plus group behavior therapy (TM plus GBT) that can encourage and help college-aged adults to quit smoking in Inner Mongolia, China?

1.2.6 How to include the most cost-effective smoking cessation intervention into the BMIURR package in Inner Mongolia, China?

1.3 Research Objectives

Topic #1: The Impact of Cigarette Smoking on Health Care Utilization among Rural Residents in China.

1.3.1 To assess how smoking affects health care utilization among rural residents in China.

1.3.2 To analyze the choice of health facility among current and former smokers in rural China.

Topic #2: The Impact of Tobacco Consumption on Rural Household Expenditure and Self-rated Health Among Rural Household Members in China.

1.3.3 To estimate how tobacco consumption affects household expenditure on other goods and services in rural China.

1.3.4 To assess the impact of tobacco consumption to self-rated health among rural household members in China.

Topic #3: Cost-Effectiveness of the Smoking Cessation Interventions Among college-aged Adults in Inner Mongolia, China.

1.3.5 To conduct the randomized controlled trial for smoking cessation intervention among college-aged adults in Inner Mongolia, China.

1.3.6 To analyze the most cost-effective smoking cessation intervention between NRT and TM plus GBT for college-aged adults in Inner Mongolia, China.

1.3.7 To propose the most cost-effective smoking cessation intervention into the BMIURR package in Inner Mongolia, China.

1.4 Conceptual Framework

Figure 1.2 presents the conceptual framework of this study and the connection of three topics of the study, namely, (1) The Impact of Cigarette Smoking on Health Care Utilization among Rural Residents in China; (2) The Impact of Tobacco Consumption on Rural Household Expenditure and Self-rated Health Among Rural Household Members in China; (3) Cost-Effectiveness of the Smoking Cessation Interventions Among college-aged Adults in Inner Mongolia, China.

This dissertation delivers insights on the impact of tobacco use on health care utilization, household expenditure, and self-rated health, and the cost-effective smoking cessation intervention. It is divided into three topics. The first topic (Chapter 2) sheds light on the impact of tobacco use on health care utilization in rural China. The results of this topic may prove that tobacco use add a great burden to the health care system in China. The second topic (Chapter 3) shows the impact of tobacco consumption on household expenditure and self-rated health in rural China. The results of this topic may prove tobacco use imposes an unwanted economic burden on tobacco consumption households and leads to enormous health burden on individual smokers. The third topic (Chapter 4) presents the most cost-effective smoking cessation intervention between NRT and TM plus GBT for college-aged adults in Inner Mongolia, China. The results of this topic may propose the most cost-effective smoking cessation intervention into the BMIURR package, reducing the burden of tobacco use.

Figure1.2 Conceptual Framework
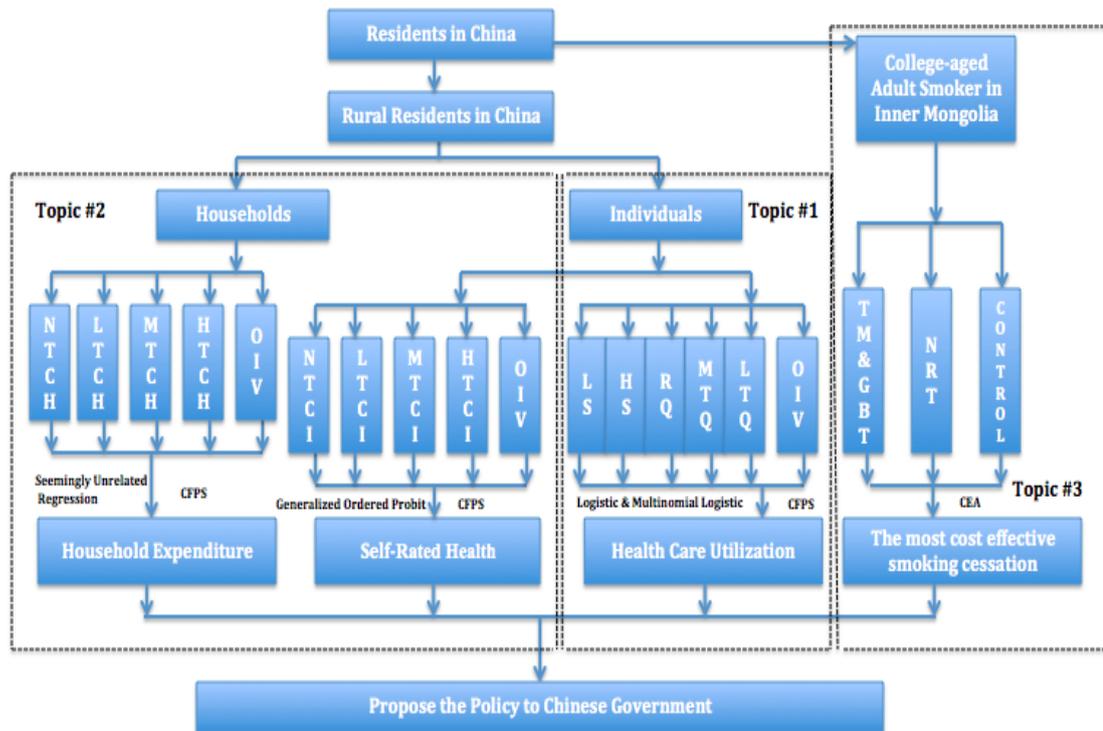
Note: Non-tobacco consumption household (NTCH), Low tobacco consumption household (LTCH), Moderate tobacco consumption household (MTCH), High tobacco consumption household (HTCH), China Family Panel Studies (CFPS), Non-tobacco consumption individual (NTCI), Low tobacco consumption individual (LTCI), Moderate tobacco consumption individual (MTCI), High tobacco consumption individual (HTCI), Light smoker (LS), Heavy smokers (HS), Recent quitter (RQ), Moderate-term quitter (MTQ), Long-term quitter (LTQ), and, Cost-effectiveness analysis (CEA). Other Independent Variables (OIV) include socioeconomic status, demographic characteristic, and health behavior and so on.

Source: Author

1.5 Scope of the Study

The current study focused on tobacco use, health care utilization, household expenditure, self-rated health, and smoking cessation program. The analysis of this study carried out in rural China (See Table 1.5).

Table 1.5 The Details of Scope of the Study

Objectives	Participants	Data Type	Data Source
To assess how smoking affects health care utilization among rural residents in China.	Rural residents above 16 years old in China	Second hand data	2010-2014 China Family Panel Studies
To analyze the choice of health facility among current and former smokers in rural China.	Rural residents above 16 years old in China	Second hand data	2014 China Family Panel Studies
To estimate how tobacco consumption affects household expenditure on other goods and services in rural China.	Rural households in China	Second hand data	2010-2014 China Family Panel Studies
To assess the impact of tobacco consumption to self-rated health among rural household members in China.	Rural residents above 16 years old in China	Second hand data	2010-2014 China Family Panel Studies
To analyze the most cost-effectiveness smoking cessation intervention between NRT and TM plus GBT for college-aged adults in Inner Mongolia, China.	College-aged adult smokers in Inner Mongolia China	First hand data	Randomized controlled trial in Inner Mongolia Medical University
To propose the most cost-effectiveness smoking cessation intervention into the BMIURR package in Inner Mongolia, China	College-aged adult smokers in Inner Mongolia China	First hand data	Randomized controlled trial in Inner Mongolia Medical University

Source: Author

At the beginning of study, the randomized controlled trial planned to be conducted in rural Inner Mongolia, China. The study should recruit rural residents as the participants of trial, and propose the most cost-effectiveness smoking cessation intervention into the NRCMS. In 2016, the NRCMS and the BMIUR have been merged into the BMIURR, and the BMIURR covers rural residents and urban unemployed. In order to propose the smoking cessation intervention to the BMIURR, the participants of trial have to include rural residents and urban unemployed residents. In the end, this study changed the participants of trial from rural residents to college-aged adults who covered rural students and urban students (urban unemployed residents).

1.6 Benefits of Research

This study will contribute to the evidence related to health care utilization, household expenditure, self-rated health, and cost-effectiveness analysis for smoking cessation intervention. The benefits from this study are as follow:

Firstly, the impact of smoking on health care utilization has been examined in developed countries, but there is limited evidence in China. The current study illustrates the difference among non-smokers, current smokers, and former smokers with respect to health care utilization in rural China.

Secondly, tobacco consumption might occupy a significant portion of rural household budgets in China, but few studies were conducted in rural China. The present study estimates tobacco consumption affecting household expenditure on other goods and services in rural China.

Thirdly, although the relationship between self-rated health and tobacco consumption has been analyzed, this relationship has not been examined in rural China. This study discovers tobacco consumption affecting self-rated health in rural China.

Fourthly, clinical studies on smoking cessations are scarce in China, particularly for young smokers. The current study indicates the most cost-effective smoking cessation interventions between NRT and TM plus GBT for college-aged adults in Inner Mongolia, China.

Finally, the BMIURR package does not include smoking cessation intervention to help the insured persons quitting smoking. The present study proposes for the policy implementation of smoking cessation intervention into the BMIURR package in Inner Mongolia China.

Chapter II

The Impact of Cigarette Smoking on Health Care Utilization among Rural
Residents in China

2.1 Motivation

An estimated 27.7% of Chinese adults (>=15 years old) were current smokers in 2015, which means there were 316 million smoking cigarettes. Even though smoking has proven to be a major cause of diseases such as cardiovascular disease, respiratory disease, cancer, only 7.0% of current smokers planned to quit smoking within one month in China (Chinese Center for Disease Control and Prevention 2016). The health hazards of the smoking result in more consumption of health services among the smokers, and further cause a substantial economic burden on Chinese society. For example, the total economic cost of smoking in China was estimated at $28.9 billion in 2008 and $57 billion in 2014, accounting for about 0.7% of China's GDP (Yang et al., 2011; World Health Organization, 2017).

Based on the above literature review, although some researchers examined the impact of smoking on health care utilization, there is limited evidence in developing countries, especially China (Rice et al., 1986; Wagner et al., 1995; Artalejo et al., 2000; Robbins et al., 2000; Izumi et al., 2001; Kahende et al., 2009; Woodruff et al., 2010; Levine et al., 2012; Lin et al., 2012; Azagba et al., 2013; Warner et al., 2013; Wacker et al., 2013; Khokhawalla et al., 2015; Keto et al., 2016; Fassmer et al., 2016). Additionally, there are few researchers using the longitudinal data set and estimating by a fixed or random effect logistic model in empirical study. To address these gaps, the first step of this study assesses how smoking affects health care utilization among rural residents in China using the fixed effect and random effect logistic models based on three waves CFPS longitudinal data set, and the second step of this study analyzes the choice of health facility among current and former smokers in rural China using a multinomial logistic model based on the third wave of CFPS.

2.2 Literature Review

2.2.1 Health Care Utilization

Health care utilization is concerned with who does and does not receive health care and why, and how much and what types of care his or her consumes among those who receive health care (Williams and Torrens, 1988). The most empirical indicators of health care utilization include its type, site, purpose, and time interval of use.

Firstly, the type of health care utilization means the kind of service received and who provide it (hospital, physician, or dentist). Secondly, the site of health care utilization refers to the place where the health care is received (outpatient department, inpatient department, or emergency department). Thirdly, the purpose of health care utilization implies a curative treatment or a preventive care. Finally, the time interval of health care utilization is expressed in term of contact, volume, and continuity measures (Aday and Andersen, 1974).

The health care utilization also can be viewed as a type of individual behavior. Societal determinants affect the individual determinants both directly and through the health services system. Different types of individual determinants then influence health care utilization (Andersen and Newman, 2005).

2.2.2 Behavioral Model of Health Services Use

The Behavioral Model of Health Services Use (BMHSU) was initially developed by Andersen (1968), and tries to help the understanding of how and why families use health services. This model originally treated a family as the unit of analysis, because an individual receives health services influencing by the demographic, social, and economic characteristics of the family. After that, Andersen changed to an individual as the unit of analysis due to the potential heterogeneity of family members.

The BMHSU has already undergone the four phases of development (Anderson, 1995; Anderson, 2008; Babitsch et al., 2012). Figure 2.1 shows the first phase of BMHSU (1960s). The BMHSU (1960s) presents that the individual's use of health services is a

function of his or her predisposition characteristics to use healthcare, enable or impede use, and his or her need for health services.

For the predisposing characteristics, firstly, demographic factors express biological imperatives suggesting the probability that an individual needs healthcare. Secondly, social structure factors include the status of a person in the society, his or her ability to deal with presenting problems. Commonly, a person's education, occupation, and ethnicity are employed to assess social structure. Health beliefs imply that an individual has values, attitudes, and knowledge about health and health services that could influence his or her subsequent perceptions of need and use of health services.

Enabling resources contain three aspects. Firstly, health personnel and facilities must be available where an individual live and work. Secondly, an individual must know how to get those health services and make use of them. Lastly, income, health insurance, travel, and waiting also are important measures in enabling resources. Perceived need factor is largely a social phenomenon. Evaluated the need means health personnel judgment about an individual's health status and his or her need for health services.

Figure 2.1 The First Phase of BMHSU (1960S)

Source: Anderson, 1995

Figure 2.2 shows the second phase of BMHSU (1970s). This model adds health care system, and emphasizes the importance of national health policy and the

resources and their organization in the health care system that influence people's use of health services.

Other development in this model is expending the measures of health services' use, which include type, site, purpose, and time interval. Moreover, this model augments consumer satisfaction as the outcome of health services' use.

Figure 2.2 The Second Phase of BMHSU (1970s)
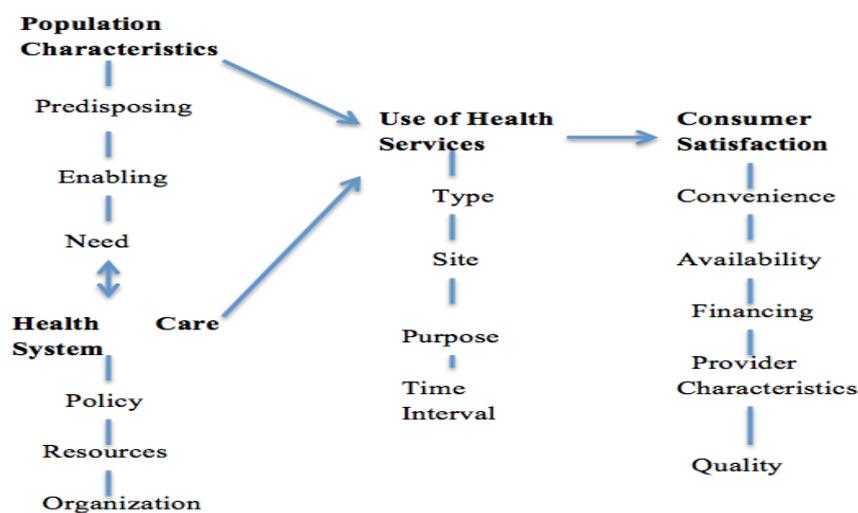
Source: Anderson, 1995

Figure 2.3 shows the third phase of BMHSU (1980s-1990s). This model realizes that health services ought to have something to do with maintaining and improving an individual's health status, both as perceived by an individual and as evaluated by health personnel. Additionally, this model adds external environment (such as physical, political, and economics components) to be an important factor for understanding use of health services.

Figure 2.3 The Third Phase of BMHSU (1980s-1990s)
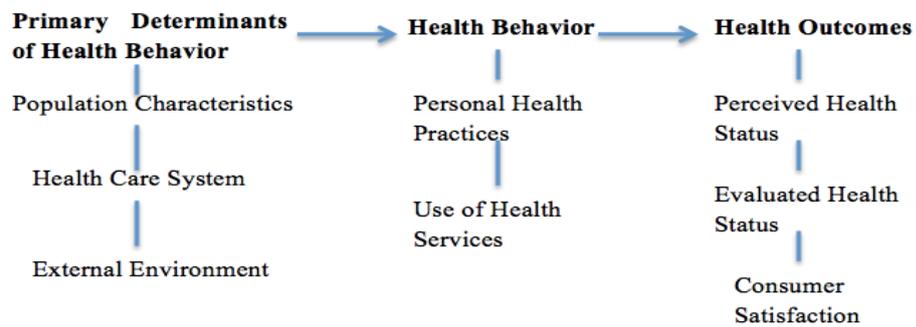
Source: Anderson, 1995

Figure 2.4 shows the forth phase of BMHSU (2000s). This model is dynamic and recursive nature of a health services' use model, and presents the multiple influences on the use of health services and health status.

Figure 2.4 The Forth Phase of BMHSU (2000s)
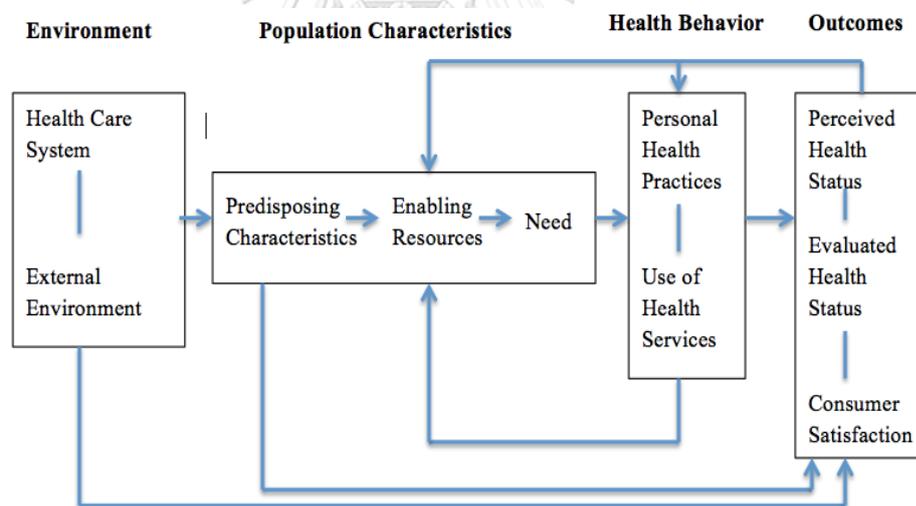
Source: Anderson, 1995

2.2.3 Theoretical Models for Health Care Utilization

2.2.3.1 Grossman's Theoretical Model

For healthcare demand researches, Grossman (1972) drew a clear distinction between health and health services, building on the insight that consumers combine

their own time with health services to create the commodity health. Additionally, the other fundamental distinction under this model is that the individual demands health and not health services.

In Grossman's theoretical model, the intertemporal utility function of a typical individual is:

$$U = U(\omega_0 H_0, \dots, \omega_n H_n, G_0, \dots, G_n) \quad (2.1)$$

where H_0 is the inherited a stock of health capital, H_i is health stock in the *ith* time period, ω_i is the service flow per unit stock, $\omega_i H_i$ is total consumption of health services, and G_i is total consumption of another commodity in the ith period. In particular, death happens when $H_i = H_{min}$. Therefore, length of life depends on the quantities of H_i that maximize utility subject to certain production and resource constraints.

Obviously, net investment in health stock equals gross investment minus depreciation:

$$H_{i+1} - H_i = I_i - \theta_i H_i \quad (2.2)$$

where I_i is gross investment and θ_i is depreciation rate during the *ith* period. The depreciation rates are assumed to be exogenous, which depends only on the age of the individual.

The individual's utility and income are both increasing functions of health capital stock, and in selecting the optimal time path of H_i, the individual bears these benefits in mind, along with the costs of holding health capital stock. The equilibrium health capital stock is defined by the condition:

$$\mu_i + \gamma_i = \{r + \theta_i - \beta_{i-1}\}\tau_i \quad (2.3)$$

where μ_i is the pecuniary marginal benefit of health capital stock, γ_i is the non-pecuniary marginal benefit of health capital stock, r is the rate of interest, τ_i is the marginal cost of investment and β_{i-1} is its percentage change (Wagstaff, 1993).

The benefit from health services is the improvement of health capital stock, but the cost of health services is a reduction in the consumption of other goods. Therefore, given the limited resources, an individual has to make a decision whether

to use health services or not based on which decision is consistent with its utility maximization. (Ellis & Mwabu, 1991; Dor et al., 1987).

2.2.3.2 Random Utility Model for Individual Choice

The random utility model provides an explanation of data on individual choices. We assign a utility level U_{xy} to each alternative $y=1,...,Y$ for each individual $x=1,...,X$. The individuals are assumed to choose the alternative y from which they derive the highest utility (Heiss, 2002).

The utilities are determined by a large amount of characteristics of the individual and the alternatives. Some of those characteristics are observed, but not on all. The utilities are divided into a deterministic part D_{xy} and a stochastic error term ε_{xy}:

$$U_{xy} = D_{xy} + \varepsilon_{xy} \quad (2.4)$$

The components of deterministic utility D_{xy} include three types of determinants: Firstly, alternative-specific constants c_y for all but one (the reference) alternative should enter the model. Secondly, individual-specific variables describe characteristics of the individual. These variables could affect the relative attractiveness of the alternatives, such as income and age (vector r_x). A parameter vector m_y for each alternative y is associated with the individual-specific variables. Thirdly, alternative-specific variables vary both over individuals and alternatives, such as the price in models of brand choice (p_{xy}). There are two parameter vectors m_y and t_y

Including all above variables, the deterministic part of the utility D_{xy} can, in general, be written as:

$$D_{xy} = c_y + p'_{ij}t_j + r'_x m_y \quad (2.5)$$

The probability P_{xy} that the individual x chooses some alternative y is equal to the probability of U_{xy} being the largest of all $U_{x1}, ..., U_{xy}$. With $I_x \in \{1 ... Y\}$ denoting the alternative that the individual x chooses, this probability is

$$P_{xy} = Pr(I_x = y) = Pr(U_{xy} > U_{xq} \ \forall q = 1, \dots Y : q \neq y)$$

$$Pr = (D_{xy} + \varepsilon_{xy} > D_{xq} + \varepsilon_{xq} \ \forall q = 1, \dots Y : q \neq y)$$

$$Pr = (\varepsilon_{xq} - \varepsilon_{xy} \leq D_{xy} - D_{xq} \ \forall q = 1, \dots Y : q \neq y \quad (2.6)$$

Given the functions $D_{x1}, \dots, D_{xY}$, this probability will depend on the assumptions on the distribution of stochastic error terms $\varepsilon_{i1}, \dots, \varepsilon_{iJ}$ (Greene, 2012).

Multinomial choice models (Y>2) and binary choice models (Y=2) can be motivated by a random utility model.

2.2.4 Tobacco Use and Health Care Utilization

Several researchers present that health care utilization of current or former smokers are higher than non-smokers in developed countries. In the United States, Rice et al. (1986) presented that the number of days stay in hospital and the number of visits to physicians were significantly higher among smokers; Wagner et al. (1995) displayed that smokers experienced a 7% to 15% increase in outpatient utilization and a 30% to 45% increase in hospital admissions over 5 to 6 years of follow-up; Robbins et al. (2000) uncovered that current smokers were more likely to have short-term rates of hospitalization regardless of gender; Kahende et al. (2009) reported that current and former smokers (quit < 2 years or >=10 years) were positively associated with inpatient care in the last year than never smokers, and current and former smokers (regardless of when they quit) were more possible to have >=4 outpatient care; Woodruff et al. (2010) indicated that daily smokers had higher rates of hospitalization and daily smokers' average number of days hospitalized was significantly longer than never smokers and other smokers; Warner et al. (2013) found that current and former smokers had a significantly increased risk of nursing home admission, and the recent quitters were at greatest risk of admission; Khokhawalla et al. (2015) showed that current and former smokers were positively associated with using emergency care compared to never smokers.

In other developed countries and regions, Artalejo et al. (2000) found that male smokers were hospitalized more frequently and made greater use of hospital emergencies compared with never smokers in Spain; Izumi et al. (2001) indicated that the increased use of inpatient service among smokers, especially in males in Japan; Levine et al. (2012) showed that current smokers were significantly related to increased health care utilization in Israel; Lin et al. (2012) discovered that the addictive behavior of smoking was significantly associated with both outpatient and inpatient utilization in Taiwan; Azagba et al. (2013) found that smokers consumed more hospitalization than never smoker, and former smokers who recently quit smoking used more health care services in Canada; Wacker et al. (2013) presented that current and former smokers had a positive relationship with the health care utilization in Germany; Keto et al. (2016) showed that middle-aged smokers visited primary health care professional more often per year than never smokers in Finland. Fassmer et al. (2016) displayed that tobacco use was related to a greater utilization of medical care among adolescents in Germany.

Above researchers adopted either the logistic regression model or the negative binomial regression model (or Poisson regression model) based on the cross section data set. For example, Artalejo et al. (2000), Kahende et al. (2009), Izumi et al. (2001), Woodruff et al. (2010), Wacker et al. (2013), Warner et al. (2013) assessed the effect of smoking status on health care utilization using a multiple logistic regression model and health care utilization was measured by binary outcome. However, Robbins et al. (2000), Woodruff et al. (2010), Lin et al. (2012), Azagba et al. (2013), Warner et al. (2013), Keto et al. (2016) examined the association between smoking status and the health care utilization using negative binomial regression model (or Poisson regression model) and health care utilization was measured by the number of uses.

2.2.5 Panel Data Sources for China

In China, three popular panel databases are freely available to researchers, which include China Health and Nutrition Survey (CHNS), China Health and Retirement

Longitudinal Study (CHARLS), and China Family Panel Studies (CFPS). Details of the panel databases are as follows:

The CHNS launches by the Carolina Population Center at the University of North Carolina at Chapel Hill and the National Institute for Nutrition and Health at the Chinese Center for Disease Control and Prevention. The study sample was drawn from 9 provinces (Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Jiangsu, Liaoning, and Shandong). A multistage random cluster technique was used to sampling here. There are approximately 4,400 households and 19,000 individuals in the each wave of survey. The first wave of the CHNS was collected in 1989, and the other 8 additional waves were collected in 1991, 1993, 1997, 2000, 2004, 2006, 2009, and 2011. The CHNS includes household survey, individual survey, nutrition and physical examination, and community survey.

The CHARLS launches by the National School of Development of Peking University. The study sample was drawn from 28 provinces. A multistage stratified PPS technique was used to sampling here. The CHARLS covered about 10,000 households and 17,500 individuals aged more than 45 years old. The first wave of the CHARLS was collected in 2011, and the other 2 additional waves were collected in 2013 and 2015. The CHARLS questionnaire includes demographic, family structure, health status, income, and consumption and so on.

The CFPS launches by the Institute of Social Science Survey of Peking University. The study sample was drawn from 25 provinces. The CFPS employed the multistage probability proportional to size sampling technique. There are about 14,000 households and 35,000 individuals in the each wave of survey. The first wave of the CFPS was collected in 2010, and the other 3 additional waves were collected in 2012, 2014, and 2016.

In summary, the CHNS is relatively limited geographic coverage, and the CHARLS focus on the elderly people. The CFPS is more appropriate for this study.

2.2.6 Tobacco Use

Tobacco use is defined as any habitual use of the tobacco plant leaf and its products. The predominant of tobacco is by smoke inhalation of cigarettes, pipes, and cigars (Braun et al., 1990). Based on Medical Dictionary, smoking is the inhalation of the smoke of burning tobacco encased in cigarettes, pipes, and cigars. Both the concepts are equivalent. Tobacco consumption is defined as the amount of household or individual's tobacco use.

Furthermore, smoking status includes current smoker, former smoker, and non-smoker (or never smoker). (1) Current smoker is someone who has smoked greater than 100 cigarettes in his or her lifetime and has smoked in the last 28 days. This group is divided into daily smoker, non-daily smoker, and social smoker. (2) Former smoker is someone who has smoked greater than 100 cigarettes in his or her lifetime but has not smoked in the last 28 days. (3) Non-smoker is someone who has never smoked, or who has smoked less than 100 cigarettes in his or her lifetime (US Centers for Disease Control and Prevention, 2017; Ministry of Health of New Zealand, 2015).

According to the questions related to smoking in the CFPS, this study modified some definitions as follows: (1) Tobacco use is defined as any habitual use of cigarettes (A thin cylinder of ground or shredded tobacco that is wrapped in paper, lit, and smoked). (2) Current smoker is someone who has smoked in the last month. (3) Former smoker is someone who has not smoked in the last month. (4) Non-smoker is someone who has never smoked.

2.3 Data and Methods

2.3.1 Data Source

This study employed three waves (2010-2014) of the China Family Panel Studies (CFPS). The CFPS is a nationally representative, biennially longitudinal survey of Chinese communities, families, and individuals. It covers twenty-five provinces and their administrative equivalents in China and it is funded by the 985 Program of Peking University and carried out by the Institute of Social Science Survey of Peking University.

The CFPS uses multistage probability proportional to size sampling and includes community questionnaire, family questionnaire, adult questionnaire, and child questionnaire. The first wave in 2010 interviewed 14,960 households with 33,600 adults (above 16 years old), and two additional waves in 2012 and 2014 interviewed 13,315 households with 35,720 adults and 13,946 households with 37,147 adults, respectively. More details about the CFPS are available from Xie & Hu (2014).

Because the current study relies on longitudinal data and rural residents in China, the study sample is restricted to 12,283 rural residents, and they were interviewed in three waves. After eliminating individuals with missing data, the final data set is 10,330 individuals in each wave.

2.3.2 Measures

First, health care utilization is measured in two perspectives: outpatient utilization and inpatient utilization. Outpatient utilization is a dummy variable that equals 1 if the individual self-reported an outpatient visit in the last two weeks and 0 otherwise, which is based on the question in adult questionnaire: "Did you visit a doctor in the past two weeks". Inpatient utilization is also a dummy variable that equals 1 if the individual self-reported hospitalization in past twelve months, which is based on the question in adult questionnaire: "Have you been hospitalized in the past twelve months".

Second, a discrete variable was used to defined choice of health facility where it took a value of 1, 2, 3, 4, and 5 for general hospital, specialized hospital, township hospital, village health center, and clinic, which was based on the questions in adult questionnaire: "If you are sick, what is the type of health service facility which you often visited".

Third, in the CFPS, each adult was asked "Are you a current smoker?" and "Are you an ex-smoker?". According to these two questions, all adults are divided into three mutually exclusive groups: non-smokers, current smokers, and former smokers. For further analysis, the present study categorizes current smokers into two sub-groups (light and heavy smokers) based on their pack year, that is, one "pack year" is 20

cigarettes smoked per day for one year. Light smokers are current smokers who had smoked <=15 pack years, and Heavy smokers smoked >15 pack years. Former smokers are categorized into three sub-groups (recent, moderate-term, and long-term quitters) based on the total years of quit smoking: recent quitters are former smokers had quit smoking <=2 years, and moderate-term quitters and long-term quitters are former smokers who had quit smoking 3-5 years and >=6 years, respectively.

Last, the other independent variables are selected based on the emerging behavioral model of health services use, and this model requires longitudinal study designs (Anderson, 1995). Predisposing factors include individual's age, gender, marital status, ethnicity, and drinking habits. Enabling factors included household income, health insurance, education level, employment status, and family size. Perceived need factor is represented by self-reported health status (see Table 2.1).

Table 2.1 Definitions of Variables

Variable	Description
Dependent variable	
Outpatient utilization	1 if the individual self-reported an outpatient visit in last two weeks; 0 otherwise
Inpatient utilization	1 if the individual self-reported hospitalization in past twelve months; 0 otherwise
Choice of health facility	1 if the individual is sick, he/she chooses general hospital; 2 if chooses specialized hospital; 3 if chooses township hospital; 4 if chooses village health center; 5 if chooses clinic
Independent variable	
Male	1 if the individual is male; 0 for female
Age group	
16-24	1 if the individual is 16-24 years old; 0 otherwise
25-34	1 if the individual is 25-34 years old; 0 otherwise
35-44	1 if the individual is 35-44 years old; 0 otherwise
45-64	1 if the individual is 45-64 years old; 0 otherwise

>=65	1 if the individual is >=65 years old; 0 otherwise
Education level	
Illiteracy	1 if the individual is illiterate; 0 otherwise
Elementary school	1 if the individual attend elementary school; 0 otherwise
Middle school	1 if the individual attend middle school; 0 otherwise
High school	1 if the individual attend high school; 0 otherwise
Above three-year college	1 if the individual attend above three-year college; 0 otherwise
Married	1 if the individual is married; 0 otherwise
Medical insurance	1 if the individual has medical insurance; 0 otherwise
Employment	1 if the individual is employed; 0 otherwise
Household income	
Low income	1 if the individual's household income belongs to 0-25% percentile; 0 otherwise
Moderate income	1 if the individual's household income belongs to 25-75% percentile; 0 otherwise
High income	1 if the individual's household income belongs to 75-100% percentile; 0 otherwise
Ethnic minorities	1 if the individual is ethnic minorities; 0 otherwise
Health status	
Bad	1 if the individual reports health status to be bad; 0 otherwise
Fair	1 if the individual reports health status to be fair; 0 otherwise
Good	1 if the individual reports health status to be good; 0 otherwise
Drinking habits	1 if the individual drinks over three times every week; 0 otherwise
Family size	A continuous variable measures in number of the household members
Smoking status	
Light smokers	1 if the individual is current smoker who had smoked <=15 pack years; 0 otherwise
Heavy smokers	1 if the individual is current smoker who had smoked >15 pack years; 0 otherwise

Recent quitters	1 if the individual is former smoker who had quitted smoking <=2 years; 0 otherwise
Moderate-term quitters	1 if the individual is former smoker who had quitted smoking 3-5 years; 0 otherwise
Long-term quitters	1 if the individual is former smoker who had quitted smoking >=6 years; 0 otherwise

Source: Author

2.3.3 Data Analysis

First, the standard Chi-square test was used to analyze the association between smoking status and health care utilization in each wave.

Second, to assess how smoking affects health care utilization among rural residents in China, the fixed effect and random effect logistic models were employed here based on the CFPS longitudinal data set. The details are as follows:

This study estimates the impact of cigarette smoking on outpatient or inpatient utilization and assumes that there is an unobserved variable y_{it}^* that called latent variable.

$$y_{it}^* = x_{it}'\alpha + \mu_i + \varepsilon_{it}$$

where x_{it} is a vector of covariates for individual i at time t, α is the coefficient estimates, μ_i is the unobserved and individual specific heterogeneity, and ε_{it} is a time-varying error term. There is a binary variable y_{it} where

$$y_{it} = \begin{cases} 1 \ if & y_{it}^* > 0 \\ 0 \ if & y_{it}^* \leq 0 \end{cases}$$

where $y_{it} = 1$ indicates that the individual self-reported outpatient utilization (or inpatient utilization); otherwise 0.

Then, the probability that $y_{it} = 1$ is

$$P(y_{it} = 1 \mid x_{it}, \alpha, \mu_i) = P(y_{it}^* > 0 \mid x_{it}, \alpha, \mu_i)$$
$$= P(x_{it}'\alpha + \mu_i + \varepsilon_{it} > 0 \mid x_{it}, \alpha, u_i)$$
$$= P(\varepsilon_{it} < \mu_i + x_{it}'\alpha \mid x_{it}, \alpha, u_i)$$
$$= F(\mu_i + x_{it}'\alpha)$$

It assumes that the error term ε_{it} follows a logistic distribution and got the following probability expressions:

$$P\big((y_{it} = 1 \mid x_{it}, \alpha, \mu_i\big) = \frac{e^{u_i + x_{it}'\alpha}}{1 + e^{u_i + x_{it}'\alpha}}$$

$$P\big((y_{it} = 0 \mid x_{it}, \alpha, \mu_i\big) = \frac{1}{1 + e^{u_i + x_{it}'\alpha}}$$

Furthermore, the assumption that μ_i is not related to x_{it} produces the random effect model. However, when μ_i is correlated to x_{it}, then it is called fixed effect model (Greene 2003).

This study uses fixed effect and random effect logistic models. The reasons for choosing these models are as follows: for many studies, the assumption of uncorrelated heterogeneity is not very realistic. In our study, a possible unobserved variable is health knowledge that may be correlated with the time-varying independent variables (e.g. health status or smoking status), so fixed effect model is a good technique to estimate a more precise result. However, when the individuals without change of the dependent variable (health care utilization) do not contribute to the likelihood, the fixed effect model lost many pieces of information. In our study, the dependent variable y_{it} shows that 5,456 individuals never receive outpatient care and 598 individuals always receive outpatient care at all three waves, so there is no variation over time and these individuals are ignored in fixed effect model. In this case, the random effect model can estimate the effect of time constant dependent variable and avoid observations missing. In summary, fixed effect or random effect model is a panacea, so this study employs both models together and performs maximum likelihood estimation to get the coefficient estimates (Andreß et al. 2013).

Third, to analyze the choice of health facility among current and former smokers in rural China, the present study used the multinomial logistic model based on the 2014 wave of CFPS. The details are as follows:

This study uses the multinomial logistic model to analyze the choice of health facility among current and former smokers. The multinomial logistic model is derived from random utility model (Heiss 2002). For the ith individual has N choices, assume that the utility of n is:

$$U_{in} = V_{in} + \varepsilon_{in}$$

where V_{in} is a deterministic part, and ε_{in} is a stochastic error term.

The probability P_{in} that individual i chooses some alternative n is equal to the probability of U_{in} being the largest of all $U_{i1}, \dots, U_{in}$.

$$P_{in} = Pr(y_i = n) = Pr(U_{in} > U_{im} \;\; \forall k = 1, \dots, N : m \neq n)$$

$$= Pr(\varepsilon_{im} - \varepsilon_{in} \leq V_{in} - V_{im} \;\; \forall k = 1, \dots, N : m \neq n)$$

It assumes that the error terms $\varepsilon_{i1}, \dots, \varepsilon_{iN}$ are independent and identically distributed as Extreme Value Type I. Under this assumption, the resulting probability P_{in}^{ML} that individual $i = 1, \dots, I$ chooses some alternative $n = 1, \dots, N$ has a straightforward and analytical solution:

$$P_{in}^{ML} = \frac{e^{V_{in}}}{\sum_{m=1}^{N} e^{V_{im}}}$$

where N indexes the choice of health facility (general hospital, etc.). Based on the above probability expression, Maximum likelihood estimation is used to get the coefficient estimates.

This study first selects "clinic" option as a base category for the estimation, and in turn chooses "village health center", "township hospital", "specialized hospital", and "general hospital", respectively. After eliminating duplicate choice sets, this study presents the estimations of choice sets such as general hospital vs. specialized hospital, general hospital vs. township hospital, general hospital vs. village health center, specialized hospital vs. township hospital, specialized hospital vs. village

health center, specialized hospital vs. clinic, township hospital vs. village health center, township hospital vs. clinic, and village health center vs. clinic.

Self-rated health and smoking status are included as regressors in this study, which are likely to be endogenous (Windmeijer & Silva, 1997). However, the present study could not apply the instrumental variables, because the dataset of CFPS did not include viable instrumental variables.

2.4 Results

Table 2.2 shows descriptive statistics for all variables in three waves. For example, the proportions of using outpatient care are 21.90% at Wave 1, 24.13% at Wave 2, and 27.62% at Wave 3. Moreover, the proportions of using inpatient care increases from 8.03% at Wave 1 to 11.50% at Wave 3.

Table 2.2 Descriptions of Variables in Three Waves (Percentage/ mean)

Variable	Wave 1 (2010)	Wave2 (2012)	Wave 3 (2014)
Gender			
Female	53.52	53.52	53.52
Male	46.48	46.48	46.48
Age			
16-24	7.82	5.75	3.77
25-34	11.73	11.11	10.41
35-44	24.60	21.41	18.41
45-64	44.85	47.78	49.61
>=65	11.00	13.94	17.80
Education			
Illiteracy (ref.)	44.42	42.14	42.10
Elementary school	23.01	25.09	25.08
Middle school	24.70	23.76	22.97

High school	6.69	7.49	7.39
Above three-year college	1.18	1.52	2.46
Married			
Yes	87.69	87.69	87.56
No	12.31	12.31	12.44
Medical insurance			
Yes	86.04	92.46	94.41
No	13.96	7.54	5.59
Employment			
Yes	57.50	58.10	75.84
No	42.50	41.90	24.16
Household income			
Low income	21.17	22.54	22.63
Moderate income	50.28	49.82	50.16
High income	28.55	27.65	27.20
Ethnic minorities			
Yes	9.74	9.74	9.74
No	90.26	90.26	90.26
Health status			
Bad	20.38	23.80	21.57
Fair	35.16	18.27	14.82
Good	44.46	57.93	63.31
Drinking			
Yes	16.21	16.35	16.24
No	83.79	83.65	83.76
Smoking status			
Non-smokers	63.18	61.21	60.15

Light smokers	12.84	11.61	11.18
Heavy smokers	19.36	18.08	17.74
Recent quitters	1.32	4.99	3.90
Moderate-term quitters	0.65	1.09	3.37
Long-term quitters	2.65	3.02	3.65
Family size (mean)	4.48	4.48	4.42
Outpatient utilization			
Yes	21.90	24.13	27.62
No	78.10	75.87	72.38
Inpatient utilization			
Yes	8.03	9.06	11.50
No	91.97	90.96	88.50
Choice of health facility			
General hospital			18.40
Specialized hospital			3.69
Township hospital			26.16
Village health center			33.95
Clinic			17.81

Note: observation: 10,300 (drop 24 observations because answer is Do not know and drop 6 observations because of no answer)

Source: Author

Table 2.3 presents the bivariate analysis for outpatient utilization by smoking status (non-, current, and former smokers) at three waves. Outpatient cares are reported more frequently for former smokers at Wave 1, and more frequently for non-smokers at Wave 2 and Wave 3. Moreover, the Chi-square test shows smoking status is significantly associated with outpatient utilization at all three waves.

Table 2.3 Outpatient Utilization in Three Waves, according to Smoking Status
(Percentage)

Smoking status	Wave 1 (2010)			Wave 2 (2012)			Wave 3 (2014)		
	Outpatient utilization			Outpatient utilization			Outpatient utilization		
	Yes	No	Chi2	Yes	No	Chi2	Yes	No	Chi2
Non-smokers	22.52	77.48		26.24	73.76		29.93	70.07	
Current smokers	20.20	79.80	10.03***	20.15	79.85	42.55***	22.52	77.48	55.76***
Former smokers	25.16	74.84		22.98	75.87		28.37	71.63	

Note: Asterisks*** indicates statistical significance at the 1% level.

Source: Author

Table 2.4 presents the bivariate analysis for inpatient utilization by smoking status (non-, current and former smoker) at all three waves. Former smokers report the highest frequency of inpatient utilization at all three waves. Moreover, the Chi-square test indicates smoking status is significantly related to inpatient utilization at all three waves.

Table 2.4 Inpatient Utilization in Three Waves, according to Smoking Status
(Percentage)

Smoking status	Wave 1			Wave 2			Wave 3		
	Inpatient utilization			Inpatient utilization			Inpatient utilization		
	Yes	No	Chi2	Yes	No	Chi2	Yes	No	Chi2
Non-smokers	8.58	91.42		9.69	90.31		11.60	88.40	
Current smokers	6.58	93.42	15.97***	6.36	93.64	53.96***	9.24	90.76	47.81***

Smoking status						
Former smokers	10.48	89.52	13.62	86.38	16.93	83.07

Note: Asterisks*** indicates statistical significance at the 1% level.

Source: Author

Table 2.5 presents the bivariate analysis for choice of health facility by smoking status (non-smokers, current smokers, and former smokers) at all three waves. First, non-smokers report more frequent visit to the village health center. Second, current smokers visit the township hospital and clinic more frequently. Last, former smokers visit the general and specialized hospital more frequently. The Chi-square test indicates smoking status is significantly related to the choice of health facility at Wave 3.

Table 2.5 Choice of Health Facility in the Third Wave, according to Smoking Status (Percentage)

Smoking status	Wave 3 (2014): Choice of Health Facility					
	General hospital	Special hospital	Township hospital	Village health center	Clinic	Chi2
Non-smokers	18.84	3.63	25.01	34.42	18.10	
Current smokers	16.00	3.54	28.19	34.02	18.26	37.94***
Former smokers	22.29	4.44	27.09	31.17	15.01	

Note: Asterisks*** indicates statistical significance at the 1% level.

Source: Author

Column (1) of Table 2.6 presents the impact of smoking status on outpatient utilization using the fixed effect logistic model. The results show that current smokers

(light and heavy smokers) and former smokers (recent, moderate-term, and long-term quitters) are positively (ORs>1) and significantly associated with outpatient utilization. However, the effect sizes are different with ORs in the range of 1.90 to 3.80. Specifically, the probabilities of light and heavy smokers using outpatient care are 116% and 90% higher than non-smokers, respectively. Moreover, the probabilities of former smokers who are recent, moderate-term, and long-term quitters using outpatient care are 106%, 164%, and 280% higher than non-smokers.

Column (2) of Table 2.6 shows the impact of smoking status on outpatient utilization using the random effect logistic model. The results display that heavy smokers and long-term quitters are positively (ORs>1) and significantly related to outpatient utilization. Heavy smokers and long-term quitters increase the probabilities of using outpatient care, recorded at 13% and 23%, respectively.

Column (1) and (2) of Table 2.6 show that the fixed effect and random effect models tell a somewhat different story. The consistent results in both models indicate that heavy smokers and long-term smokers are positively (ORs>1) and significantly related to outpatient utilization.

Column (3) of Table 2.6 presents the impact of smoking status on inpatient utilization using the fixed effect logistic model. The results indicate that recent, moderate-term, and long-term quitters are positively (ORs>1) and significantly associated with inpatient utilization. The ORs show that the individuals are former smokers (recent, moderate-term, and long-term quitters), and the probabilities of using inpatient care increase by 212%, 173%, and 336%.

Column (4) of Table 2.6 presents the impact of smoking status on inpatient utilization using the random effect logistic model. Current smokers (light and heavy smokers) are negatively (ORs<1) related to inpatient utilization at the 0.10 and 0.05 significance level. However, former smokers (recent, moderate-term, and long-term quitters) are positively (ORs>1) and significantly associated with inpatient utilization. Current smokers (light and heavy smokers) decrease the probabilities of using inpatient care by 16% and 20%. On the contrary, former smokers (recent, moderate-term, and long-term quitters) increase the probabilities of using inpatient care by 78%, 50%, and 31%.

Column (3) and (4) of Table 2.6 uncover that the fixed effect and random effect models estimate the different results. The consistent results in both models, which indicate that former smokers (recent, moderate-term, and long-term quitters) are positively (ORs>1) and significantly associated with inpatient utilization. However, the effect sizes of the fixed effect model are much greater than those from the random effect model.

The full estimation results of the fixed and random effect logistic regression analysis of health care utilization appeared in Appendix A.

Table 2.6 Fixed and Random Effect Logistic Regression Analysis of Health Care Utilization

	Outpatient utilization		Inpatient utilization	
	Fixed effect	Random effect	Fixed effect	Random effect
	(1)	(2)	(3)	(4)
No. of observations	12,828	30,990	6,792	30,900
Cons	-	0.10***	-	0.04***
Male	-	0.69***	-	1.03
Age group, years				
16-24 (ref.)	1.00	1.00	1.00	1.00
25-34	1.28	1.45***	1.24	1.06
35-44	1.46	1.84***	1.05	0.68***
45-64	1.78**	2.45***	1.51	1.07
>=65	2.08**	3.16***	1.63	1.53***
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.00
Elementary school	1.80**	1.00	1.64	0.91
Middle school	12.36**	0.94	0.53	0.95
High school	10.56**	0.98	0.52	0.98

Above three-year college	5.21	0.87	0.62	1.10
Married	0.67**	0.93	1.65**	1.45***
Medical insurance	1.09	1.16**	1.26**	1.27***
Employment	1.22***	1.19***	0.91	0.76***
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.00
Low income	1.07	1.03	1.19**	1.07
High income	1.02	0.97	0.95	1.01
Ethnic minorities	-	0.68***	-	1.30***
Family size	0.99	1.03***	1.01	1.01
Health status				
Fair (ref.)	1.00	1.00	1.00	1.00
Good	0.64***	0.42***	0.71***	0.57***
Bad	3.07***	4.68***	2.00***	2.85***
Drinking habits	0.89	0.80***	0.71***	0.76***
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.00
Light smokers	2.16***	1.04	1.54	0.84*
Heavy smokers	1.90**	1.13*	1.23	0.80**
Recent quitters	2.06***	1.00	3.12***	1.78***
Moderate-term quitters	2.64***	1.23	2.73**	1.50**
Long-term quitters	3.80***	1.23*	4.36***	1.31*

Note: Asterisks*** indicates statistical significance at the 1% level, ** at the 5% level, * at the 10% level.

Source: Author

Hausman test provides a way to compare fixed effect and random effect. The null hypothesis is that the preferred model is random effect, and the alternate

hypothesis is that the preferred model is fixed effect. Table 2.7 shows that the P-value (0.0000) is less than 0.05, and we reject the null hypothesis. In this study, the preferred model is fixed effect logistic regression model.

Table 2.7 The result of Hausman Test

	Coefficients			
	(b)	(B)	(b-B)	S.E.
	Fixed effect	Random effect	Difference	
Age group, years				
25-34	0.25	0.37	-0.13	0.18
35-44	0.38	0.61	-0.23	0.24
45-64	0.58	0.90	-0.32	0.27
>=65	0.73	1.15	-0.42	0.29
Education				
Elementary school	0.59	0.00	0.59	0.23
Middle school	2.51	-0.06	2.58	1.19
High school	2.36	-0.02	2.37	1.18
Above three-year college	1.65	-0.13	1.78	1.24
Married	-0.40	-0.08	-0.32	0.16
Medical insurance	0.08	0.15	-0.07	0.04
Employment	0.20	0.18	0.02	0.03
Household income				
Low income	0.07	0.03	0.04	0.04
High income	0.02	-0.03	0.05	0.04
Family size	-0.01	0.03	-0.04	0.02
Health status				

	(1)	(2)	(3)	(4)
Good	1.12	1.54	-0.42	0.04
Bad	-0.45	-0.86	0.41	0.03
Drinking habits	-0.11	-0.23	0.12	0.07
Smoking status				
Light smokers	0.72	0.00	0.72	0.25
Heavy smokers	0.97	0.21	0.76	0.28
Recent quitters	1.33	0.21	1.12	0.43
Moderate-term quitters	1.12	1.54	-0.42	0.04
Long-term quitters	-0.45	-0.86	0.41	0.03

Test: H_0: difference in coefficients not systematic

Chi2 (22)=509.55 Prob>chi2=0.0000

Source: Author

Table 2.8 displays the choice of health facility among current smokers and former smokers. The following is the interpretation of the multinomial logistic regression regarding relative risk ratios.

First, Column (3) of Table 2.8 shows that for recent and long-term quitters, the relative risk for visiting the general hospital relative to the village health center would be expected to increase by a factor of 1.36 and 1.49, respectively, given that the other variables in the model are held constant. It implies that recent and long-term quitters are more likely to visit the general hospital over the village health center.

Second, Column (4) of Table 2.8 presents for heavy smokers, the relative risk for visiting the general hospital compared to the clinic would be expected to decrease by a factor of 0.79 given that the other variables in the model are held constant. Namely, heavy smokers are less likely to visit the general hospital over the clinic. Moreover, for recent and long-term quitters, the relative risk for visiting the general hospital as opposed to the clinic would be expected to increase by a factor of 1.54 and 1.42, respectively, given that the other variables in the model are held constant. It means that recent and long-term quitters are more likely to visit the general hospital over the clinic.

Third, Column (6) of Table 2.9 displays that for former smokers who are recent and long-term quitters, the relative risk for visiting the specialized hospital relative to the village health center would be expected to increase by a factor of 1.68 and 1.88, respectively, given the other variables in the model are held constant. It implies that recent and long-term quitters are more likely to visit the specialized hospital over the village health center. Moreover, Column (7) of Table 2.9 presents similar results that recent and long-term quitters are more likely to visit specialized hospitals over clinics.

Four, Column (8) of Table 2.9 discovers that for moderate-term quitters, the relative risk for visiting the township hospital relative to the village health center would be expected to increase by a factor of 1.42 given the other variables in the model are held constant. It means that moderate-term quitters are more likely to visit the township hospital over the village health center.

Lastly, Column (10) of Table 2.9 uncovers that for heavy smokers and moderate-term quitters, the relative risk for visiting the village health center relative to the clinic would be expected to decrease by a factor of 0.79 and 0.71, respectively, given that the other variables in the model are held constant. It implies that heavy smokers and moderate-term quitters are less likely to visit the village health center over the clinic.

The full estimation results of the multinomial logistic regression analysis of the choice of health facility appeared in Appendix B.

Table 2.8 Multinomial Logistic Regression Analysis of the Choice of Health Facility

Smoking status	Choice of health facility				
	General hospital vs. Specialized hospital (1)	General hospital vs. Township hospital (2)	General hospital vs. Village health center (3)	General hospital vs. Clinic (4)	Specialized hospital vs. Township hospital (5)
Non-smokers (ref.)	1.00	1.00	1.00	1.00	1.00

Light smokers	0.74	0.88	1.04	0.95	1.19
Heavy smokers	0.81	0.91	1.00	0.79[*]	1.12
Recent quitters	0.81	0.94	1.36[*]	1.54[**]	1.59
Moderate-term quitters	1.02	1.34	1.34	0.95	0.93
Long-term quitters	0.79	1.24	1.49[**]	1.42[*]	1.57

Note: Asterisks[**] at the 5% level, [*] at the 10% level.

Source: Author

Table 2.9 Multinomial Logistic Regression Analysis of the Choice of Health Facility (Cont.)

Smoking status	Choice of health facility				
	Specialized hospital vs. Village health center (6)	Specialized hospital vs. Clinic (7)	Township hospital vs. Village health center (8)	Township hospital vs. Clinic (9)	Village health center vs. Clinic (10)
Non-smokers (ref.)	1.00	1.00	1.00	1.00	1.00
Light smokers	1.40	1.28	1.18	1.08	0.92
Heavy smokers	1.23	0.97	1.11	0.87	0.79[*]
Recent quitters	1.68[*]	1.90[**]	1.06	1.20	1.13

| Moderate-term quitters | 1.32 | 0.94 | 1.42** | 1.01 | 0.71* |
| Long-term quitters | 1.88** | 1.79* | 1.20 | 1.14 | 0.95 |

Note: Asterisks** at the 5% level, * at the 10% level.

Source: Author

2.5 Discussions

First, the results from the fixed effect logistic model revealed that current and former smokers use more outpatient care than non-smokers. Only former smokers utilize more inpatient care than non-smokers. Results from the random effect logistic model indicated that heavy smokers and long-term quitters use more outpatient care than non-smokers and former smokers use more inpatient care than non-smokers. The common explanations are that smoking has adverse health effects and causes some diseases, so current and former smokers are more likely to use outpatient care than non-smokers. Moreover, former smokers use more outpatient and inpatient care since many former smokers quit smoking because they may have experienced serious sickness. Based on the above results, smokers are significantly predicted to have higher health care costs, which are supported by several studies in China (Chen et al., 1995; Jin et al., 1995; Sung et al., 2006; Yang et al., 2011;). Moreover, New Rural Cooperative Medical System (NRCMS) was implemented in 2003 and covered almost all rural households in China, but the sources of financing NRCMS are no difference between smokers and non-smokers. Under certain circumstances non-smokers may subsidize the health care costs of smokers.

Second, the results from the random effect logistic model discovered that current smokers use less inpatient care than non-smokers. There are two possible reasons: (1) Current smokers may not care about their health status or may be a less risk adverse individual (Izumi et al., 2001). (2) For current smokers, the health consequence of smoking may appear several years later (Rezayatmand et al., 2017).

Third, the current study showed that former smokers use more inpatient care than non-smokers, and according to the random effect logistic model, long-term quitters decrease the probability of using inpatient care compared with recent and moderate-term quitters. Moreover, moderate-term quitters have a much lower probability of using inpatient care than recent quitters based on the fixed effect logistic model. All above results may imply that people live healthier and longer lives, and they reduce the risk for numerous diseases when quit smoking for a long period of time. (Taylor et al., 2002; Heikkinen et al., 2008; Jha et al., 2013). It is well that quit smoking is not easy, but smoking cessation therapies can boost the chances of quitting smoking (Wu et al., 2006).

Fourth, based on the multinomial logistic model, this study discovered that recent and long-term quitters have a much higher probability of visiting the general hospital compared to vising the village health center and the clinic. Moreover, recent and long-term quitters are more likely to visit the specialized hospital compared to visiting the village health center and the clinic. Heavy smokers are negatively associated with visiting the general hospital and the village health center compared with the clinic.

Fifth, the current study employed the pack-year to categorize current smokers (light and heavy smokers), which is likely superior to some previous studies. In the past studies, researchers either categorized by the number of cigarettes smoked or by the number of years smoked. However, pack-year combines the number of cigarettes smoked and the number of years smoked at the same time. Pack-year is important for clinic research and is significantly associated with risk of disease, and health service research may widely use it to measure smoking status.

Although this study used the national longitudinal survey to analyze the smoking status affecting health care utilization among rural residents in China, there are several limitations. Firstly, this study measured outpatient utilization based on the question "Did you visit a doctor in the past two weeks", and it might underestimate the utilization of outpatient care among rural residents in China. Secondly, the CFPS did not collect the number of times respondents had visited a physician (or inpatient utilization), with this limitation, this present study could not further analyze the impact

of smoking status on the number of health care uses. Thirdly, the choice of health facility was measured at all three waves, but the question was slightly different. Specifically, the respondents were first asked: "If you are a little sick, how do you deal with it", and if the respondents answered "see a doctor" they were then asked "what is the type of health service facility which you often visited" at Wave 1. However, the respondents were directly asked "If you are sick, what is the type of health service facility which you often visited" at Wave 2 and Wave 3. These varying questions caused many missing values at Wave 1 and 6,701 of 10,330 respondents answering the same choice at Wave 2 and Wave 3. With this limitation, this study employs the multinomial logistic model based on the cross-sectional data set (Wave 3) rather than the longitudinal data set. Finally, the number of former smokers is relatively small, especially for the analysis of inpatient utilization. For example, only 76 former smokers who had quit for 3-5 years visited inpatient care at all three waves.
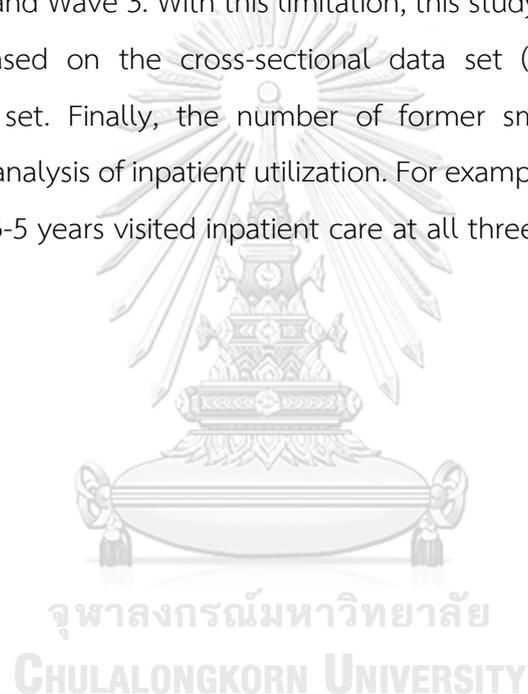
Chapter III

The Impact of Tobacco Consumption on Rural Household Expenditure and Self-rated Health Among Rural Household Members in China

3.1 Motivation

In 2015, an estimated 28.1% of adults (above 15 years old) in China (52.9% of men vs. 2.4% of women) were current smokers, and among those people, 44.8% of men and 2.0% women were daily smokers (Chinese Center for Disease Control and Prevention, 2016). As we know, tobacco consumption has a negative long-term effect on health, in addition, it may have a negative short-term impact on household expenditure, affecting not only the smokers but the rest of household members as well.

With households under severe resource constraints, household members spending on tobacco has an opportunity cost because other desired goods or services have to be foregone. In 2013 rural China, the proportion of population below the national poverty line was 8.5% much higher than urban areas (about 2%) (United Nations Statistics Division, 2013). Moreover, the prevalence of smoking was significantly higher in rural residents (29.4%) as compared to residents of urban areas (26.1%) in 2015 (Chinese Center for Disease Control and Prevention, 2016). Tobacco consumption might occupy a significant portion of household budgets in rural China, but few studies were conducted in rural China.

It is well known that tobacco consumption is a risk factor for heart disease, cancer, and other diseases, and it has caused 24.9% of male and 12.8% of female deaths in China (The Tobacco Atlas, 2017). Previous studies indicated that premature mortality is strongly related to tobacco consumption (Thun et al., 2007; US Department of Health and Human Services, 2004), and that premature mortality is significantly related to self-rated health (Heistaro et al., 2011; Idler & Benyamini, 1997). Although several studies have analyzed the relationship between self-rated health and tobacco consumption, this relationship has not been examined in rural China.

Based on the above information, a national longitudinal survey is used to show the harm of tobacco consumption on smokers and their households. The objectives of this paper are (1) to estimate how tobacco consumption affects household expenditure on other goods and services in rural China; (2) to assess the impact of tobacco consumption to self-rated health among rural household members in China.

3.2 Literature Review

3.2.1 Household Expenditure

Household expenditure also is the amount of final consumption spending made by households to meet the needs and want of its members, such as food, clothing, housing, energy, transport, durable goods, health cost, leisure, and various services. Non-consumption spending such as loan repayment, income taxes, and purchase of houses is excluded (OECD, 2018).

For the consumption categories, different surveys are slightly different. The categories of household expenditure in China Family Panel Studies are food, dress, housing, daily expense, health care, communication and traveling, education, entertainment, and other. However, in Singapore Household Expenditure Survey, the categories of household expenditure are food and non-alcoholic beverages, alcoholic beverages and tobacco, clothing and footwear, housing and utilities, furnishings, household equipment and routine household maintenance, health, transport, communication, recreation and culture, educational services, food serving services, accommodation services, and miscellaneous goods and services (Department of Statistics Singapore, 2017; Wu et al., 2014).

3.2.2 Crowd Out Effect of Tobacco Consumption

As we know, tobacco consumption is not only a dangerous behavior, but it is also an expensive addiction. Given resource constraints, an individual consumes on tobacco has an opportunity cost because other desired goods or services have to foregone.

Efroymson et al. (2001) used a descriptive analysis to assess the impact of tobacco consumption on the poor in Bangladesh, and showed that tobacco spending exacerbates the effects of poverty and cause significant deterioration in living standards among the poor. Busch et al. (2004) employed a Seeing Unrelated Regression method based on Almost Ideal Demand System (AIDS) to evaluate tobacco expenditure crowds out other goods in the US, and showed that comparing with non-smokers, smokers spend less on housing. Wang et al. (2006) applied a Fractional Logit model to estimate the impact of tobacco spending on household spending pattern in rural China, and presented that the expenditure on tobacco affects education, health, farming equipment and seed, saving, and insurance. John (2008) conducted the Seeing Unrelated Regression method based on the Quadratic Almost Ideal Demand System (QUAIDS) to examine whether spending on tobacco crowds out spending on other commodities in India, and revealed that the household of tobacco consumption has lower spending on milk, education, clean fuels, and entertainment. John et al. (2012) used the Seeing Unrelated Regression method based on the QUAIDS to assess the impact of tobacco expenditure on the consumption of other goods in Cambodia, and found that tobacco expenditure crowds out expenditure on education. Chelwa and Walbeek (2014) used the Seeing Unrelated Regression method based on the QUAIDS to assess the impact of tobacco spending on household expenditure pattern in Zambia, and uncovered that smoking households spends less on food, schooling, clothing, transportation, and equipment maintenance.

3.2.3 Quadratic Almost Ideal Demand System

Following Pollak (1969) presented conditional demand function, and John (2008) revised the object of function from individuals to households. The function assumed that the household's consumption of one good has been predetermined. Due to tobacco consumption as an expensive addiction, this study assumed a household has already pre-allocated a certain amount of budget on tobacco. The household has maximized its utility subject to the expenditure excluded pre-allocated tobacco expenditure (See Equation 2.7).

$$Max\ U = U(g_1, \ldots, g_n; \boldsymbol{A})\ \ s.t\ \sum_{i=1}^{n-1} p_i g_i = T\ \text{(2.7)}$$

where tobacco (g_n) is the nth good, n-1 goods (g_i) are available in the market for the prices (p_i), the total expenditure is T (excludes the expenditure on tobacco), A presents a vector of household characteristics.

The solution for this utility maximization problem (only for n-1 goods), the conditional demand function was used (Equation 2.8).

$$g_i = f^{i,n}(p_1, \ldots, p_{n-1}, T, g_n, \boldsymbol{A})\ \text{(2.8)}$$

The conditional demand function can be used to test whether zero expenditure on tobacco arise from corner solutions (consumers cannot afford tobacco products based on its current price and their current income) or abstention (some consumers will not smoke even if tobacco products were available for free). John (2008) and Vermeulen (2003) found that zeros on tobacco are due to abstention, rather than corner solutions.

Because direct price information is not available for all goods, the study is to assess how tobacco consumption affects household expenditure on other goods, and can only estimate Engel curves instead of the conditional demand function as in Equation 2.8. The Engel curves from Quadratic Almost Ideal Demand System (QUAIDS) were employed here (Banks et al., 1997).

The QUAIDS is derived from a generalization of Price-Independent Generalized Logarithmic (PIGLOG) developed by Muellbauer (1976), which starts from an indirect utility function (See Equation 2.9).

$$\ln V = \left\{ \left[\frac{\ln I - \ln \alpha(p)}{\beta(p)} \right]^{-1} + \theta(p) \right\}^{-1} \text{(2.9)}$$

where I is household income, $\alpha(p), \beta(p),$ and $\theta(p)$ are functions of the vector of prices p. The term $\frac{\ln I - \ln \alpha(p)}{\beta(p)}$ is the indirect utility function of the PIGLOG demand system, and

required $\alpha(p)$ is homogenous of degree one in p, and $\beta(p)$ and $\theta(p)$ homogenous of degree zero in p.

Equation 2.10 shows the usual translog form of the $\ln \alpha(p)$:

$$\ln \alpha(p) = \alpha_0 + \sum_j \alpha_j \ln p_j + \frac{1}{2} \sum_i \sum_j \gamma_{ij} \ln p_i \ln p_j \quad (2.10)$$

Equation 2.11 presents the $\beta(p)$ that is the simple Cobb-Douglas price aggregator.

$$\beta(p) = \prod_{i=1}^{n} p_i^{\delta_i} \quad (2.11)$$

Equation 2.12 demonstrates the $\theta(p)$.

$$\theta(p) = \sum_{i=1}^{n} \theta_i \ln p_i \text{ where } \sum_i \theta_i = 0 \quad (2.12)$$

By using Roy's identity to the indirect utility function, the budget shares in the QUAIDS is presented as Equation 2.13:

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \delta_i \ln \left[\frac{I}{\alpha(p)}\right] + \frac{\theta_i}{\beta(p)} \left\{\ln \left[\frac{I}{a(p)}\right]\right\}^2 \quad (2.13)$$

3.2.4 Measurement of Self-rated Health

Self-rated health (also known as self-reported health, self-assessed health, or self-perceived health) refers to a single item health measure in which individuals rate the current status of their own health, and it is a simply easy to administer measure of general health (Bombak, 2013; Wu et al., 2013).

A various set of questions and response options have been applied to measure self-rated health (See Table 3.1). However, it can be classified into three main categories: non-comparative, age-comparative, and time-comparative (Eriksson, 2001).

Table 3.1 Example of Questions and Responses on Self-rated Health

Category	Question	Response
	Do you consider yourself a healthy, fairly healthy, sick or very sick person?	Healthy to very sick Four-point scale
Non-comparative	How would you describe your health status at present?	Excellent to poor Four or five-point scale
	How would you assess your own health condition?	Excellent to not healthy at all Five-point scale
Age-comparative	What do you think of your won health status compared to that of other men of your age?	Better to worse Three-point scale
Time-comparative	How would you rate your own health compared to the last year?	Better to worse Three-point scale

Source: Author

3.2.5 Tobacco Use and Self-rated Health

Few studies have been employed to analyze the relationship between tobacco use and self-rated health. Ho et al. (2003) revealed that former smokers significantly have the worst perceived health status, and current smokers have much worse perceived health status than never smokers. Prokhorov et al. (2003) found that current smokers give themselves the poorest health ratings, but former and non-smokers give themselves the best health ratings. Lyons et al. (1994) showed that former smokers report a significantly worse health experience. Blaylock and Blisard (1992) presented that current smokers have lower probability to report good health status than non-smokers. All of above researches reach the same conclusion, which is that there is significantly relationship between tobacco use and self-rated health.

3.2.6 Generalized Ordered Probit Model

The ordered probit model is built around a latent regression (See Equation 2.14).

$$y_i^* = x_i'\beta + \varepsilon_i \quad (2.14)$$

where y^* is unobserved. However, we can observe as follows (See Equation 2.15).

$$y_i = 0 \; if \; y_i^* \leq 0$$

$$= 1 \; if \; 0 < y_i^* \leq \mu_1$$

$$= 2 \; if \; \mu_1 < y_i^* \leq \mu_2$$

$$\dots$$

$$= G \; if \; \mu_{G-1} < y_i^* \quad (2.15)$$

where μ's are unknown parameters to be estimated with β.

We assume that ε is normally distributed across observations, and normalize the mean and variance of ε to zero and one (See Equation 2.16).

$$E[\varepsilon_i] = 0 \; and \; Var[\varepsilon_i] = 1 \quad (2.16)$$

We then have the following probabilities equations:

$$Prob(y_i = 0|x_i) = \theta(-x_i'\beta)$$

$$Prob(y_i = 1|x_i) = \theta(\mu_1 - x_i'\beta) - \theta(-x_i'\beta)$$

$$Prob(y_i = 2|x_i) = \theta(\mu_2 - x_i'\beta) - \theta(\mu_1 - x_i'\beta)$$

$$\dots$$

$$Prob(y_i = G|x) = 1 - \theta(\mu_{G-1} - x_i'\beta) \quad (2.17)$$

where $0 < \mu_1 < \mu_2 < \cdots < \mu_{G-1}$

One obstacle to the ordered probit model is parallel lines assumption, and it follows that the coefficient vector β is the same for all categories g. This assumption

implies that with the increase in independent variable, and the cumulated distribution shifts to the right or left (no shift in the slope of the distribution).

Relaxing the parallel lines assumption, the generalized ordered probit model is as follows:

$$\mu_{ig} = \mu_g + x_i'\vartheta \quad (2.18)$$

where the threshold parameters are individual specific and depend on the covariates.

With three outcomes, the probabilities are formed from:

$$y_i = 0 \; if \; y_i^* \leq 0$$

$$= 1 \; if \; 0 < y_i^* \leq \mu + x_i'\vartheta$$

$$= 2 \; if \; \mu + x_i'\vartheta < y_i^* \quad (2.19)$$

for three outcomes, the model has two thresholds, $\mu_0 = 0$ and $\mu_1 = \mu + x_i'\vartheta$. The probabilities equations are as follows:

$$Prob(y_i = 0|x_i) = \theta[-(\alpha + x_i'\beta)]$$

$$Prob(y_i = 1|x_i) = \theta[(\mu + x_i'\vartheta) - (\alpha + x_i'\beta)] - \theta[-(\alpha + x_i'\beta)]$$

$$Prob(y_i = 2|x_i) = 1 - \theta[(\mu + x_i'\vartheta) - (\alpha + x_i'\beta)] \quad (2.20)$$

The generalized ordered probit model leads to the estimation of *G-1* binary probit models. The first model estimates category *1* vs. categories *2,…,G*; the second model categories *1* and *2* vs. *3,…, G*; the last model categories *1,…, G-1* vs. category *G*. This specification allows for individual heterogeneity in the coefficient vector *β* (Boes, 2007; Schneider et al., 2012; Greene, 2012).

3.3 Data and Methods

3.3.1 Data Source

The data used in this study was from China Family Panel Studies (CFPS), funded by 985 Program of Peking University and launched by the Institute of Social Science Survey of Peking University. The CFPS is a national representative, biennially longitudinal survey of Chinese communities, families, and individuals. The survey sample was drawn from 25 provinces or administrative equivalents representing 94.5% of total population in China. 5 provinces or administrative equivalents (Liaoning, Shanghai, Henan, Guangdong, and Gansu) were selected to oversample populations, and the remaining 20 provinces or administrative equivalents were grouped together. The survey of CFPS employed the multistage probability proportional to size sampling technique. More details of the data collection process were given in Xu and Lu (2015). The first wave in 2010 covered 14,960 households with 33,600 individuals (above 16 years old), and two additional waves in 2012 and 2014 included 13,315 households with 35,720 individuals and 13,946 households with 37,147 individuals, respectively. The CFPS consists of the following modules: demographics, family structure/transfer, health status and functioning, biomarkers, health care and insurance, work, income and consumption, assets (individual and household), and community level information.

Because the present study relies on longitudinal data to assess the impact of tobacco consumption in rural China, the study sample was restricted to the rural 6,095 households with 12,283 individuals, and they were interviewed in three waves. It is worth noting that there are 1,592 households with missing consumption expenditure values (food, dress, and housing et al.) among 6,095 households. Moreover, there is no information regarding the average amount of consumption at community level in this database and mean imputation for missing data could not have been used. Therefore, this study classified two level data sets (one for household and another for individual). After all missing data have been eliminated, the household level data set included 3,611 households in each wave, and the individual level data set contained 10,610 individuals in each wave.

3.3.2 Measures

3.3.2.1 Tobacco Consumption Status

Tobacco consumption status was assessed by the following three questions in the questionnaire of CFPS: (1) Are you a current smoker? (2) Are you an ex-smoker? (3) If you are a current smoker, how many cigarettes do you smoke each day? All members of the household over 16 years were interviewed. For example, first, those who answered "yes" in the first question were defined as current smokers. Second, those who answered "no" in the first question and "yes" in the second question were defined as ex-smokers. Third, those who answered "no" in the first question and "no" in the second question were defined as non-smokers. Current smoker's daily cigarette consumption was measured from the third question.

Consequently, to estimate household tobacco consumption the present study estimated from the sum of current smoker's daily cigarette consumption in the same household in each wave of CFPS. From these estimations, all households were divided into four mutually exclusive groups: group 1 (non-tobacco consumption household), group 2 (low tobacco consumption household), group 3 (moderate tobacco consumption household) and group 4 (high tobacco consumption household). Group 1 was those with non- or ex-smokers. Group 2, or households with at least one current smoker were classified by household tobacco consumption which was below the 25th percentile. Group 3 was defined as between the 25th and 75th percentile, and group 4 was defined as above the 75th percentile. In the same way that tobacco consumption households are grouped, current smokers were categorized as low- (below the 25th percentile), moderate- (between the 25th and 75th percentile), or high tobacco consumption individuals (above the 75 percentile) based on how much he/she consumed tobacco per day.

3.3.2.2 Household Consumption Expenditure

The household questionnaire contained a set of detailed questions about household expenditures, and the project team of CFPS created the composite

variables of household consumption expenditure categories for the sake of convenience of data users. These composite variables included nine distinct spending categories: food, dress, housing, daily expense, health care, communication and traveling, education, entertainment, and other.

Regarding to the food expenditure item, tobacco and alcohol consumption were included in food expenditure as well. According to the requirement of the following equation (1), food expenditure only included the food items except for tobacco and alcohol items in this study. Thanks to the question "In the last month, how much did your family spend on cigarettes and alcohol?" that was asked in 2010 wave and 2012 wave, the current study could extract cigarettes and alcohol spending from food expenditure. However, in 2014 wave there was no information related to the tobacco and alcohol consumption separated from the other food expenditure. Based on the above limitation of three waves database, three waves data are used to estimate the following equation (1) separately, so all the data of the three waves could not be used all together.

3.3.2.3 Self-rated Health Status

Lastly, the single question measuring self-rated health can be classified into three categories, which are non-comparative self-rated health (typically measured by asking the interviewees whether they would rate their health as very poor, poor, fair, good, or excellent), age-comparative self-rated health (generally measured by asking the interviewees whether they would rate their health as worse, the same or better if compared to that of other people of their age), and time-comparative self-rated health (commonly the respondents are asked to rate their health compared to how it was at a given time in the past) (Eriksson et al., 2011). Only time-comparative self-rated health was collected by three waves of CFPS, and it has been chosen as a measurement of health status.

Table 3.2 describes all variables in this study and provides summary statistics for each.

Table 3.2 Definitions of Variables

Variable	Description
Household level	
Category of household consumption expenditure[a] (%)	
Food	Annual food expenditure (including rice, flour, meats, vegetables, fruits, etc. except for tobacco and alcohol)
Dress	Annual dress expenditure (including clothing, shoes, hats, scarf, etc.)
House	Annual residence expenditure (including fuels, heating, water and electricity, house rent, etc.)
Daily	Annual homes durables and decorations, daily expenditure (including household items and personal toiletries that used daily plus beauty treatments)
Health	Annual health care expenditure (including direct medical expenditure, health care products, and fitness expenditure)
Trco	Annual local transportation, communication fees (including post, internet usage, telephone, and cell phone usage)
Edu	Annual education expenditure (including tuition, training fees, etc.)
Ent	Annual entertainment expenditure (including fees to buy books, newspapers, VCDs, DVDs, going to cinema, and internet bars)
Other	The expenses not included in above categories
Household tobacco consumption status (%)	
NTH	No consumption of tobacco among household members.

LTCH	Dummy variable: 1 if household tobacco consumption in the 0-25% percentile, 0 if otherwise.
MTCH	Dummy variable: 1 if household tobacco consumption in the 25-75% percentile, 0 if otherwise.
HTCH	Dummy variable: 1 if household tobacco consumption in the 75-100% percentile, 0 if otherwise.
Age[a]	Age of household head
Gender (%)	Dummy variable: 1 if household head is a male, 0 if otherwise.
Education status (%)	
No education	Household head is illiterate. Omitted group.
Elementary school	Dummy variable: 1 if household head finished elementary school, 0 if otherwise.
Middle school	Dummy variable: 1 if household head finished middle school, 0 if otherwise.
High/ vocational school	Dummy variable: 1 if household head finished high/vocational school, 0 if otherwise.
College or above	Dummy variable: 1 if household head finished college, 0 if otherwise.
Marital status (%)	
Cohabitated	Household head is cohabitated. Omitted group.
Unmarried	Dummy variable: 1 if household head is unmarried, 0 if otherwise.
Married	Dummy variable: 1 if household head is married, 0 if otherwise.
Divorced	Dummy variable: 1 if household head is divorced, 0 if otherwise.
Widow	Dummy variable: 1 if household head is a widow, 0 if otherwise.
Self-rated health status (%)	
Same	Household head's self-rated health status is same compared with last year. Omitted group.

Worse	Dummy variable: 1 if household head's self-rated health status is worse compared with last year, 0 if otherwise.
Better	Dummy variable: 1 if household head's self-rated health status is better compared with last year, 0 if otherwise.
Employment (%)	Dummy variable: 1 if household head is employed, 0 if otherwise.
Family size[a]	Number of members with the household
Ethnicity (%)	Dummy variable: 1 if household head is ethnic minority, 0 if otherwise.
Drinking (%)	Dummy variable: 1 if at least one household member drinks at least 3 times a week, 0 if otherwise
Insurance (%)	Dummy variable: 1 if household head has public health insurance, 0 if otherwise.
	Individual level
Self-rated health status (%)	=0 if the individual rated their health to be worse compared with last year
	=1 if the individual rated their health to be same compared with last year
	=2 if the individual rated their health to be better compared with last year
Individual tobacco consumption status (%)	
NS	Dummy variable: 1 if the individual is non-smoker (never smoking), 0 if otherwise.
LTCI	Dummy variable: 1 if the individual tobacco consumption in the 0-25% percentile, 0 if otherwise.
MTCI	Individual tobacco consumption in the 25-75% percentile. Omitted group.

HTCI	Dummy variable: 1 if the individual tobacco consumption in the 75-100% percentile, 0 if otherwise.
ES	Dummy variable: 1 if the individual is ex-smoker, 0 if otherwise.
Age[a]	Age of individual
Gender (%)	Dummy variable: 1 if the individual is a male, 0 if otherwise.
Education status (%)	
No education	Individual is illiterate. Omitted group.
Elementary school	Dummy variable: 1 if the individual finished elementary school, 0 if otherwise.
Middle school	Dummy variable: 1 if the individual finished middle school, 0 if otherwise.
High/ vocational school	Dummy variable: 1 if the individual finished high/vocational school, 0 if otherwise.
College or above	Dummy variable: 1 if the individual finished college, 0 if otherwise.
Marital status (%)	
Cohabitated	Individual is cohabitated. Omitted group.
Unmarried	Dummy variable: 1 if the individual is unmarried, 0 if otherwise.
Married	Dummy variable: 1 if the individual is married, 0 if otherwise.
Divorced	Dummy variable: 1 if the individual is divorced, 0 if otherwise.
Widow	Dummy variable: 1 if the individual is a widow, 0 if otherwise.
Household income (%)	
Low income	Dummy variable: 1 if household income in the 0-25% percentile, 0 if otherwise.
Middle income	Dummy variable: 1 if household income in the 25-75% percentile, 0 if otherwise.
High income	Dummy variable: 1 if household income in the 75-100% percentile, 0 if otherwise.

Employment (%)	Dummy variable: 1 if the individual is employed, 0 if otherwise.
Family size[a]	Number of members with the household
Ethnicity (%)	Dummy variable: 1 if the individual is ethnic minority, 0 if otherwise.
Insurance (%)	Dummy variable: 1 if the individual has public health insurance, 0 if otherwise.

[a] indicates mean value; [b] includes tobacco and alcohol.

Source: Author

3.3.3 Data Analysis

3.3.3.1 Descriptive Statistics

Descriptive statistics were calculated for household and individual tobacco consumption status, household expenditure categories, and self-rated health. The proportion of household budget share on the different categories by household tobacco consumption status was calculated and Student t test was used to test the differences in expenditures shares between households with (low, moderate and high) and without tobacco consumption (expressed as percentage points) in each wave. Moreover, the standard chi-square test was applied to analyze the association between self-rated health and individual tobacco consumption status in each wave.

3.3.3.2 Quadratic Almost Ideal Demand System

To assess the impact of tobacco consumption on rural household spending on other goods and services in China (also known as the crowding-out effect), The Quadratic Almost Ideal Demand System (QUAIDS) developed by Banks, Blundell, and Lewbel (1997) was employed here. QUAIDS is consistent with utility theory and is derived from the Almost Ideal model. However, the difference is that the QUAIDS enables some goods to be luxuries at some income levels and necessities at others income levels. Vermeulen (2003), John (2008), John et al., (2012), and Chelwa and Walbeek (2014) have used the QUAIDS model to do similar analyses. The present study

assumes that the rural household is a single utility maximizer and estimates the following system equation of Engel curves in household level:

$$w_{hit} = (\alpha_h + \beta_h \mathbf{a}_{it}) + (\gamma_{1h} LTCH_{it} + \gamma_{2h} MTCH_{it} + \gamma_{3h} HTCH_{it} + \gamma_{4h} Drink_{it}) +$$

$$\delta_h \ln T_{it} + \theta_h (\ln T_{it})^2 + \mu_{hit} \tag{4.1}$$

where h is the category of household consumption expenditure, i is the household, t is the survey wave, w_{hit} is the household i budget share on the hth expenditure category in t wave. T_{it} is total household expenditure excluding tobacco and alcohol expenditure and $\ln T_{it}$ is the natural logarithm of T_{it}. $\mathbf{a}_{it}$ is the vector of demographic and socioeconomic characteristics of the household including the log of family size, household head's age, gender, education, marital status, self-rated health, ethnicity, insurance, and employment. $Drink_{it}$ is also dummy variable with the value 1 if the household consumes alcohol (0 otherwise). μ_{hit} is the error term.

Ordinarily, the QUAIDS model (Vermeulen, 2003; John, 2008, and Pu et al., 2008) is estimated with tobacco price as explanatory variable. In the absence of price data, this study assumed tobacco consumption households face the same tobacco price, and developed four dummy variables instead of tobacco expenditure. $LTCH_{it}$, $MTCH_{it}$, and $HTCH_{it}$ are dummy variables that are defined as low tobacco consumption household, moderate tobacco consumption household, and high tobacco consumption household, respectively.

The regressors tobacco consumption households ($LTCH_{it}$, $MTCH_{it}$, and $HTCH_{it}$) are potentially endogenous (John, 2008). Instrumental variables techniques should be used, which produce consistent and unbiased estimates. However, the current study could not apply the instrumental variables, because the CFPS dataset does not contain the viable instrumental variables.

This study estimates the system equation of (4.1) using the Seemingly Unrelated Regression model and employing random effect estimators in the context of longitudinal data (Zellner, 1962; Biørn, 2004). The 'other' expenditure category is selected as a reference and was moved from the system of equation (4.1).

3.3.3.3 Random Effect Generalized Ordered Probit model

To detect factors causing heterogeneity in self-rated health among adults aged 16 years old and above in rural China, the current study uses the random effects generalized ordered probit model. The model was chose for three reasons: (1) the outcome of self-rated health is an ordinal scale and appropriate for the normal distribution (Greene, 2003); (2) the random effects ordered probit model has been much more widely used than the fixed effects model (Galenkamp et al., 2011); (3) the assumption of parallel lines is often violated, generalized ordered probit model can relax this assumption.

Firstly, the random effects ordered probit model is built from a latent regression and is defined as follows:

$$y_{it}^* = x_{it}a + \beta_1 NS_{it} + \beta_2 LTCI_{it} + \beta_3 HTCI_{it} + \beta_4 ES_{it} + \varepsilon_{it} \quad (4.2)$$

x_{it} is the vector of demographic and socioeconomic characteristics of the individual including age, gender, education, marital status, ethnicity, insurance, employment, family size, and household income. NS_{it}, $LTCI_{it}$, $HTCI_{it}$ and ES_{it} are dummy variables that are defined as the non-smoker, low tobacco consumption individual, high tobacco consumption individual, and ex-smoker. y_{it}^* is an unobserved latent variable linked to the observed ordinal response categories SRH_{it}.

$$SRH_{it} = \begin{bmatrix} 0 & if \ y_{it}^* \le \mu_1 \\ 1 & if \ \mu_1 < y_{it}^* \le \mu_2 \\ 2 & if \ \mu_2 \le y_{it}^* \end{bmatrix} \quad (4.3)$$

The μ mean thresholds were estimated using a maximum likelihood estimation, subject to the constraint that $\mu_1 < \mu_2$. It is noteworthy that the random effects ordered probit model relies on the parallel lines assumption, which means the coefficient vector a and β_1-β_4 are the same for three categories of self-rated health. However, the parallel lines assumption is often violated in reality.

Secondly, the random effects generalized ordered probit model relaxes the parallel lines assumption of standard ordered probit model and allows the coefficients to vary across the self-rated health (Pfarr et al., 2010; Schneider et al., 2012).

$$SRH_{it} = \begin{bmatrix} 0 & if\ y_{it}^* \leq \tilde{\mu_1} + \chi_i\lambda_1 \\ 1 & if\ \tilde{\mu_1} + \chi_i\lambda_1 < y_{it}^* \leq \tilde{\mu_2} + \chi_i\lambda_2 \\ 2 & if\ \tilde{\mu_2} + \chi_i\lambda_2 \leq y_{it}^* \end{bmatrix} \qquad (4.4)$$

This method induces two binary probit models: the first model estimates SRH=0 vs. SRH=1 and SRH=2, and the second model estimates SRH=0 and SRH=1 vs. SRH=2. This study estimates the effect of individual tobacco consumption status on SRH using the random effects ordered probit model and the random effects generalized ordered probit model and compares the result of two models.

The regressors tobacco consumption is potentially endogenous. For example, risk aversion is an unobserved variable that might lead an individual never smoke and maintain good health status (Leigh & Schembri, 2004). Instrumental variables technique can solve above problem, but the CFPS dataset does not contain the viable instrumental variables, which did not allow further exploration of potential endogeneity,

3.4 Results

Table 3.3 shows descriptive statistics for all variables in three waves.

Table 3.3 Descriptions Statistics in 2010, 2012, and 2014

Variable	The first wave (2010)	The second wave (2012)	The third wave (2014)
Household level			
Category of household consumption expenditure[a] (%)			

Food	30.82	28.70	37.07[b]
Dress	5.49	7.37	5.81
House	5.10	9.88	13.53
Daily	12.18	11.94	9.24
Health	17.74	15.85	13.44
Trco	14.03	11.82	11.06
Edu	11.39	9.98	8.22
Ent	0.38	0.21	0.12
Other	2.87	4.25	1.51
Household tobacco consumption status (%)			
NTH	37.84	40.49	41.79
LTCH	18.60	18.77	19.63
MTCH	31.22	27.48	26.50
HTCH	12.34	13.26	12.07
Age[a]	49.31	51.29	53.29
Gender (%)	78.96	78.96	78.96
Education status (%)			
No education	36.40	34.15	34.15
Elementary school	26.27	28.54	28.55
Middle school	27.54	26.96	26.97
High/ vocational school	8.63	9.13	9.06
College or above	1.16	1.22	1.27
Marital status (%)			
Cohabitated	0.25	0.28	0.28
Unmarried	2.68	2.24	2.16
Married	90.87	89.93	89.37

Divorced	1.08	1.27	1.14
Widow	5.12	6.28	7.05
Self-rated health status (%)			
Same	34.04	37.36	37.97
Worse	52.12	54.03	52.17
Better	13.84	8.61	9.86
Employment (%)	63.24	64.07	82.14
Family size[a]	4.13	4.10	4.04
Ethnicity (%)	9.58	9.58	9.58
Drinking (%)	32.00	32.36	29.05
Insurance (%)	87.74	94.02	95.04
N	3,611	3,611	3,611
Individual level			
Self-rated health status (%)	32.05	37.01	37.08
	52.79	53.31	52.03
	15.16	9.68	10.90
Individual tobacco consumption status (%)			
NS	62.10	60.18	59.12
LTCI	11.56	11.23	11.61
MTCI	16.98	15.07	14.54
HTCI	3.15	4.02	3.49
ES	6.21	9.50	11.24
Age[a]	46.66	48.65	50.65
Gender (%)	47.38	47.38	47.38
Education status (%)			

No education	44.07	41.78	41.74
Elementary school	23.08	25.16	25.16
Middle school	24.97	23.85	23.08
High/ vocational school	6.71	7.70	7.50
College or above	1.17	1.51	2.52
Marital status (%)			
Cohabitated	0.19	0.21	0.26
Unmarried	6.89	5.75	4.84
Married	87.49	87.54	87.46
Divorced	0.64	0.77	0.82
Widow	4.79	5.73	6.62
Household income (%)			
Low income	21.18	22.39	22.63
Middle income	50.38	49.88	50.12
High income	28.44	27.73	27.25
Employment (%)	57.42	58.13	75.83
Family size[a]	4.49	4.48	4.42
Ethnicity (%)	9.79	9.79	9.79
Insurance (%)	85.99	92.39	94.34
N	10,610	10,610	10,610

[a] indicates mean value; [b] includes tobacco and alcohol.

Source: Author

Table 3.4-3.6 displays the household expenditure and household tobacco consumption status in three waves. A negative percentage point difference (D1-D3) implies that tobacco consumption households (low, moderate or high tobacco consumption households) allocate on average a smaller share to these nine distinct spending categories than non-tobacco consumption households. When tobacco

consumption households were compared to the non-tobacco consumption households, the former consistently showed significantly lower budget shares: the first wave reports lower health care, education, and other spending; the second wave reports lower food and health care spending; the third wave reports lower health care, entertainment, and other spending.

Table 3.4 Household Budget Allocations between Non-tobacco and Tobacco Consumption Household in Rural China (%)

| | NTH | The first wave (2010) | | |
		LTCH (D1)	MTCH (D2)	HTCH (D3)
Food	30.75	30.42 (-0.33)	30.91 (0.15)	31.43 (0.68)
Dress	5.16	5.31 (0.15)	5.74 (0.58**)	6.17 (1.01***)
House	5.10	4.91 (-0.19)	5.01 (-0.09)	5.61 (0.51)
Daily	11.87	12.35 (0.48)	12.58 (0.71*)	11.89 (0.02)
Heatlh	19.35	18.94 (-0.41)	16.24 (-3.11***)	14.74 (-4.61***)
Trco	12.95	13.96 (1.01**)	14.46 (1.51***)	16.33 (3.38***)
Edu	11.59	11.52 (-0.07)	11.86 (0.27)	9.40 (-2.19**)
Ent	0.24	0.48 (0.24**)	0.42 (0.18***)	0.57 (0.33***)
Other	2.99	2.11 (-0.88**)	2.78 (-0.21)	3.85 (0.86*)
N	1365	762	1128	446

Note: Asterisks *** indicates statistical significance at the 1% level, **indicates statistical significance at the 5% level, *indicates statistical significance at the 10% level. D_1 is different between LTC and NSH; D_2 is different between MTC and NSH; D_3 is different between HTC and NSH.

Source: Author

Table 3.5 Household Budget Allocations between Non-tobacco and Tobacco Consumption Household in Rural China (%) (Cont.)

| | The second wave (2012) | | | |
	NTH	LTCH (D1)	MTCH (D2)	HTCH (D3)
Food	30.08	26.32 (-3.76***)	27.91 (-2.17***)	29.50 (-0.58)
Dress	6.98	6.91 (-0.07)	7.98 (1.00***)	7.97 (0.99***)
House	9.56	10.98 (1.42***)	9.86 (0.30)	9.34 (-0.22)
Daily	11.42	11.78 (0.36)	12.29 (0.87*)	13.02 (1.60**)
Heatlh	17.14	17.41 (0.27)	14.40 (-2.74***)	12.70 (-4.44***)
Trco	10.86	11.33 (0.47)	12.71 (1.85***)	13.60 (2.74***)
Edu	9.62	10.22 (0.60)	10.75 (1.13*)	9.11 (-0.51)
Ent	0.18	0.22 (0.04)	0.21 (0.03)	0.26 (0.08)
Other	4.16	4.82 (0.66)	3.88 (-0.28)	4.50 (0.34)
N	1461	678	993	479

Note: Asterisks *** indicates statistical significance at the 1% level, **indicates statistical significance at the 5% level, *indicates statistical significance at the 10% level. D_1 is different between LTC and NSH; D_2 is different between MTC and NSH; D_3 is different between HTC and NSH.

Source: Author

Table 3.6 Household Budget Allocations between Non-tobacco and Tobacco Consumption Household in Rural China (%) (Cont.)

| | The third wave (2014) | | | |
	NTH	LTCH (D1)	MTCH (D2)	HTCH (D3)
Food				
Dress	10.17	9.64 (-0.53)	9.74 (-0.43)	10.37 (0.20)
House	21.94	22.37 (0.43)	22.96 (1.02)	23.67 (1.73*)

Daily	14.39	14.83 (0.44)	14.51 (0.12)	15.25 (0.86)
Heatlh	22.73	19.83 (-2.90***)	18.81 (-3.92***)	17.24 (-5.49***)
Trco	17.63	17.74 (0.11)	20.00 (2.37***)	20.68 (3.05***)
Edu	10.88	13.64 (2.76***)	12.05 (1.17*)	10.46 (-0.42)
Ent	0.23	0.18 (-0.05)	0.17 (-0.06**)	0.27 (0.04)
Other	2.03	1.76 (-0.27*)	1.77 (-0.26*)	2.06 (0.03)
N	1509	709	957	436

Note: Asterisks *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level, * indicates statistical significance at the 10% level. D_1 is different between LTC and NSH; D_2 is different between MTC and NSH; D_3 is different between HTC and NSH.

Source: Author

Although the Student t test reports a formal test for the differences in mean shares in Table 3.4, it does not control for demographic and socioeconomic characteristics of the household that may affect budget allocation. With this limitation, this study uses the regression model in the system of equation (1) in order to control characteristics of household. Table 3.7 shows the results of tobacco consumption on rural household spending on other goods and services. In the table, two sets of results are displayed. The first three columns contain the results of two waves (2010 and 2012), and the last three columns the results of three waves (2010, 2012 and 2014). The current study does not report the coefficients of control variables for the sake of brevity. The average budget share for food is less than

In the first three columns, low tobacco consumption households assign significantly lower budget shares to food. Moreover, the average budget share for food is less than 1.95 percentage point. Tobacco consumption significantly reduces the budget allocation to health care among moderate- and high tobacco consumption households. On average, the budget allocations to health care are 1.44 and 3.47 percentage points lower. High tobacco consumption households decrease, on average, 2.20 percentage point in their budget for education.

In the last three columns, low tobacco consumption households reduce, on average, 0.57 percentage point in their budget for dress. Tobacco consumption devotes lower budget allocation to health care among moderate and high tobacco consumption households. On average, in moderate and high, the budget allocation to health care is 1.80 and 4.83 percentage points lower, respectively. High tobacco consumption households allocate significantly lower budget shares to education, with a 2.14 percentage point difference.

The full estimation results of the tobacco consumption impact on rural household expenditure in rural China appeared in Appendix C.

Table 3.7 Tobacco Consumption Impact on Rural Household Expenditure in Rural China

Expenditure categories	Two waves (2010, 2012)			Three waves (2010, 2012, 2014)		
	LTCH	MTCH	HTCH	LTCH	MTCH	HTCH
Food	-1.95***	-0.70	0.42			
Dress	-0.33	0.42**	1.13***	-0.57**	0.03	1.18***
House	0.51	0.05	0.76*	0.66	0.03	0.88
Daily	0.20	0.41	0.13	0.05	0.25	0.42
Health	0.95	-1.44**	-3.47***	-0.37	-1.80***	-4.83***
Trco	0.22	1.22***	2.92***	-0.06	1.28***	3.99***
Edu	0.26	0.15	-2.20***	0.59	0.42	-2.14***
Ent	0.13**	0.09*	0.17**	0.06	0.06	0.21***

Note: Asterisks *** indicates statistical significance at the 1% level, **indicates statistical significance at the 5% level, *indicates statistical significance at the 10% level.

Source: Author

Table 3.8-3.10 displays individual tobacco consumption status and SRH. In the three waves, individuals with high tobacco consumption were more likely to report their health to be worse when compared to the previous year, and ex-smokers were more likely to rate their health to be better when compared with the year before.

Moreover, the Chi-square test shows that tobacco consumption status is significantly associated with SRH in three waves.

Table 3.8 Self-rated Health among Non-smoker, Current Smoker and Ex-smoker in Rural China (%)

	The first wave				
	HW	HS	HB	N	Chi2
NS	32.01	52.30	15.59	6589	
LTCI	31.38	54.85	13.77	1227	
MTCI	32.19	54.11	13.71	1802	15.67[**]
HTCI	35.03	53.29	11.68	334	
ES	31.91	50.00	18.09	658	

Note: Health to be worse (HW), Health to be same (HS), Health to be better (HB). Number of observations (N). Asterisks [***] indicates statistical significance at the 1% level.

Source: Author

Table3.9 Self-rate Health among Non-smoker, Current Smoker and Ex-smoker in Rural China (%) (Cont.)

	The second wave				
	HW	HS	HB	N	Chi2
NS	37.54	52.28	10.18	6385	
LTCI	35.15	55.29	9.56	1192	
					19.59[**]
MTCI	35.96	55.85	8.19	1559	
HTCI	38.97	55.16	5.87	426	

ES	36.71	52.68	10.62	1008

Note: Health to be worse (HW), Health to be same (HS), Health to be better (HB). Number of observations (N). Asterisks *** indicates statistical significance at the 1% level.

Source: Author

Table3.10 Self-rated Health among Non-smoker, Current Smoker and Ex-smoker in Rural China (%) (Cont.)

	The third wave				
	HW	HS	HB	N	Chi2
NS	37.62	51.04	11.33	6273	
LTCI	34.25	55.28	10.47	1232	
MTCI	34.61	56.12	9.27	1543	28.32***
HTCI	42.28	49.32	8.40	369	
ES	38.73	49.37	11.90	1193	

Note: Health to be worse (HW), Health to be same (HS), Health to be better (HB). Number of observations (N). Asterisks *** indicates statistical significance at the 1% level.

Source: Author

Table 3.11 presents the results of tobacco consumption affecting SRH among rural household members, and shows the results of two types of estimations. The first column includes the results of the random effects ordered probit estimation, and the other two columns show the results for the random effects generalized ordered probit estimation that consists of two binary probit models.

First of all, the random effects generalized ordered probit estimation presents that the magnitude of the coefficients and the level of significance are different between the two binary probit models. The coefficients of NS are significant in both equations, and their values are 0.11 and 0.12, respectively. The above results show that individuals who have never smoked are more likely to rate a better health status,

but the effect is higher for SRH categories 0-1 vs. 2. Similarly, the effect of variable ES for SRH categories 0-1 vs. 2 is much greater than 0 vs. 1-2. The values of HTCI are -0.12 and -0.13 in two equations, which means that individuals who consume large amounts of tobacco are less likely to report a better health status. Moreover, the effect is lower for categories 0 vs. 1-2.

Secondly, the ordered probit and generalized order probit estimation indicated that all tobacco consumption variables show the expected significant result, but the variable LTCI shows the unexpected sign and insignificant result. The two estimations above show that SRH has a significantly positive coefficient with respect to non-smokers and ex-smokers indicating that if the individual is a non-smoker or ex-smoker, he/ she will be more likely to report his/her health status as better or positive. Moreover, SRH is more liable to be rated negatively if the individuals consume more tobacco.

Finally, the significant variables of the ordered probit estimation are consistent with the generalized ordered probit estimation. In contrast, the effects of significant variables in the generalized ordered probit estimation are stronger than the ordered probit estimation with the exception of ex-smokers (0 vs. 1-2).

The full estimation results of the tobacco consumption impact on self-rated health in rural China appeared in Appendix D.

Table3.11 Tobacco Consumption Impact on Self-rated Health in Rural China

Tobacco consumption status	Ordered probit	Generalized ordered probit	
		0 vs. 1-2	0-1 vs. 2
NS	0.09***	0.11***	0.12***
LTCI	0.02	0.03	0.03
HTCI	-0.11**	-0.12**	-0.13*
ES	0.09***	0.07*	0.15***

Note: Asterisks *** indicates statistical significance at the 1% level, **indicates statistical significance at the 5% level, *indicates statistical significance at the 10% level.

Source: Author

3.5 Discussions

The present study found that tobacco consumption crowds out expenditures on food, dress, health care, and education for rural households in China. Similar results have been discovered in China and other low- and middle-income countries. For example, Wang et al. (2006) and Xin et al. (2009) found that tobacco spending/consumption households significantly reduce investments in education and medical care in China. A study was conducted by John et al. (2012) in Cambodia, indicating that households with expenditure on tobacco crowd out expenditure on education and dress. John (2008) presented that tobacco consumption households allocated lower budget shares on milk, education, and entertainment in India. This longitudinal study provides strong evidence that tobacco consumption households reduce spending on health care and education; besides, the result of this study provides new evidence about tobacco consumption households also spending less on food and dress in rural China. Therefore, if tobacco consumption households stopped consuming tobacco and spent the money on health, education, food, and dress instead, rural households could improve their overall standard of living (Hu et al., 2005).

The results of this study shown in table 3.5 illustrated that high tobacco consumption households reduce much more spending on health care and education compared with other tobacco consumption households. The magnitude of the crowd out effect is much higher among high tobacco consumption households and it should be given high priority in reducing tobacco consumption.

The United Nations Convention on the Rights of the Child (CRC) emphasizes that children have the right to access health care services, to have adequate nutritious foods, and to receive education. The above results show that tobacco consumption households spend less on health care, education, and food in rural China. Although China committed to promoting children's rights and ratified the United Nations CRC in 1992, tobacco consumption may deprive the above children's rights in rural China. In the long run, tobacco consumption may be a disservice to future generations.

Smoking induces related diseases and leads to greater health care costs, so the household with smokers may spend more on health care. However, this study found that tobacco consumption households spend less on health care. On the one hand, the CFPS collected the category of health care expenditure that included direct medical spending, health care products, and fitness. Tobacco consumption may increase household spending more on medical care but is more likely to crowd out household spending on health care products and fitness. On the other hand, New Rural Cooperative Medical Scheme (NRCMS) was implemented since 2003 and covered almost all rural households. Furthermore, NRCMS continuously increases service and cost coverage, which may reduce direct medical expenditure on smoking-related diseases among rural tobacco consumption households (Meng & Xu, 2014).

The current study also revealed that the assessment of individual health varies with tobacco consumption status in rural China. Non-smokers and ex-smokers are more likely to report their health status as better compared to last year. However, high tobacco consumption individuals have more possibility to rate their health status as worse compared to the previous year. These results are comparable to previous findings in different countries (Holahan et al., 2012; Heikkinen et al., 2008; Yen et al., 2010). There is a better chance that the ex-smokers will report better health compared to last year and this finding proves that quitting may improve self-rated health status.

Although the present study employs the national longitudinal survey to analyze the tobacco consumption affecting rural household expenditure and self-rated health among rural household members, there are several limitations. Firstly, the CFPS did not collect data on households spending on tobacco directly. With this restriction, the model of QUAIDS used in this study selected household tobacco consumption instead of household tobacco spending as the independent variables. Cigarette prices do not vary considerably in rural China because rural households popularly choose cheap local brands. However, this study may underestimate tobacco consumption affecting rural household expenditure on richer rural households when they buy more expensive cigarette brands. Secondly, the CFPS did not confirm the head of household in each wave, so this study appoints a member of the household as the head according to the related issue in the first wave questionnaire and supposes that the head of

household is always the same person in the following two waves. Lastly, non-comparative SRH was also measured in three waves, but it used the different symmetrical scale. Specifically, five categories: very poor, poor, fair, good, or very good in the first wave, but poor, fair, good, very good, or excellent in the other two waves. This study has to choose three categories of time-comparative SRH and may have some problems of sensitivity.

จุฬาลงกรณ์มหาวิทยาลัย

CHULALONGKORN UNIVERSITY

Chapter IV

Cost-Effectiveness of the Smoking Cessation Interventions Among college-aged Adults in Inner Mongolia, China

4.1 Motivation

In China, 18.9% of 15-24 years olds, 29.5% of 25-44 years olds, 32.4% of 45-64 years olds, and 25.1% of above 65 years olds people were current smokers (Chinese Center for Disease Control and Prevention, 2016). Although the prevalence of smoking amongst 15-24 years of young people were the lowest ratio compared to other age groups, there are several reasons why smoking cessation interventions should be provided among the young smokers. Firstly, the rate of smoking among young men (15 to 24 years old) increased by more than 6.5% from 2010 to 2015, which led to an increased the demand of the smoking cessation interventions targeting young smokers. More importantly, unless young smokers quit smoking, at least the half of them will finally be killed by their habit in China (Chen et al., 2015). Secondly, In 2015, 8.9% of 15-24 years old, 7.2% of 45-64 years old, 6.7% 25-44 years old, and above 65 years old smokers planned to quit smoking within one month in China (Chinese Center for Disease Control and Prevention, 2016). These statistics imply that more young smokers want to quit compared to other age groups. Moreover, there was evidence that young smokers tended to think they are less addicted, and think they would quit smoking much easier than other smokers (Weinstein et al., 2004). Thirdly, smokers who quit at younger ages could obtain greater life extensions. Namely, quit smoking as early as possible is important (Taylor et al., 2002).

The rate of smoking-cessation is at very low levels in China. There was a report showing that 31.5% of smokers tried to quit smoking in past 12 months, but only 23.6% of smokers quit smoking over 24 hours (Chinese Center for Disease Control and Prevention, 2016). Moreover, 91.8% of smokers who had tried to stop smoking in past 12 months had never received quitting assistance, and it implies that insufficient smoking cessations services may led to the low cessation rate in China (Chinese Center for Disease Control and Prevention, 2010). Furthermore, clinical studies on smoking

cessations also are inadequate in China, particularly for young smokers. Only a randomized controlled study presented that text messaging was an effective intervention for smoking cessation among Chinese adolescent smokers.

To address these gaps, the current study will conduct a randomized controlled trial for smoking cessation intervention among college-aged adults in Inner Mongolia, China, and analyze the most cost-effective smoking cessation intervention for college-aged adults in Inner Mongolia, China.

4.2 Literature Review

4.2.1 Effect of Nicotine

The primary reason why individuals smoke is that they are nicotine dependent. When individuals smoked, the nicotine is rapidly from the lung to reach the brain. Nicotine has a distributional half-life of 15-20 minutes and a terminal half-life in blood of two hours. Smokers experience a pattern of repetitive and transient high blood nicotine concentrations from each cigarette, with regular hourly cigarettes needed to maintain nicotine levels and avoid symptoms of withdrawal (Jarvis, 2004).

4.2.2 Smoking Cessation Interventions

4.2.2.1 Nicotine Replacement Therapy

There are six different types of NRT that are nicotine transdermal patch, nasal spray, gum, lozenge, inhaler, and sublingual tablet in the world (McEwen et al., 2008), but only the nicotine patch and gum are available in China. The details see Table 4.1.

Table 4.1 Descriptions of Six Types of NRT

Type	Description
Nicotine transdermal patch	A patch is available in 16 and 24-hour preparations, which releases about 1 mg of nicotine per hour. The patch is very simple to use, and applied to a clean,

	dry, and hairless area of skin in the morning and remove them after 16 or 24 hours.
Nicotine nasal spray	It releases a fine spray of nicotine to the nasal mucosa, and it is very quickly absorbed in about ten minutes and particularly helpful for highly addicted nicotine smokers.
Nicotine gum	There are two types of nicotine gum that are 2 mg and 4mg, and highly nicotine dependent smokers should use the 4 mg gum. The piece of gum should be chewed slowly in order to release the nicotine.
Nicotine lozenge	There are three types of nicotine lozenge that are 1mg, 2 mg, and 4 mg, and 1 mg or 2 mg for less nicotine dependent smokers and 2 mg or 4 mg for more dependent smokers. The nicotine lozenge should be dissolved in the mouth and moved it around intermittently, and it can be removed after 30 minutes.
Nicotine inhalator	The nicotine inhalator consists of a small plastic tube including a replaceable nicotine cartridge, and it can be used for 20 minutes each hour. The inhalator does not let the nicotine inhale into the lungs, and the nicotine deposited on the oral mucosa.
Nicotine sublingual tablets	It is a small 2 mg tablet and can be dissolved under the tongue. In order to achieve the best effect, the tablet should be used hourly.

Source: Author

4.2.2.2 Non-nicotine Pharmacotherapies

Bupropion or Zyban is only a non-nicotine pharmacotherapy for smoking cessation, and it is available in China. It is noted that the Bupropion is a safe medication, but smokers who want to use it need to be prescribed by their GP (McEwen et al., 2008).

4.2.2.3 Behavioral Support

Behavioral support delivers advice, discussion, and encouragement, and it takes many different forms, from individual to group, open or closed group, face to face, or over the telephone or Internet. The behavioral support interventions generally use behavior change techniques, dealing with such as motivation and self-efficacy. The most common and readily available behavioral support interventions include brief advice/interventions, individual behavioral counseling, group behavior therapy, text messaging, telephone counseling, and self-help materials (Roberts et al. 2013).

4.2.3 Previous Studies of Smoking Cessation Intervention among Young Smokers

There were several studies on smoking cessation services for young smokers (See Table 4.2). Almost all the studies conducted in developed countries, especially USA, and the smoking cessation services conducted in the studies fall into three categories: Behavioral support (Buller et al., 2014; Witkiewitz et al., 2014; Shi et al., 2013; O'Neill et al., 2000; Haug et al., 2009; Oermayer et al., 2004; Skov-Ettrup et al., 2014; Riley et al., 2008; An et al., 2008; Prochaska et al., 2015; Harris et al., 2010; Abroms et al., 2008), Nicotine Replacement Therapy (Rubinstein et al., 2008; Roddy et al., 2006; Hanson et al., 2003), and Non-nicotine pharmacotherapies (Killen et al., 2004). Additionally, a majority of the researchers conducted the randomized controlled trial, and the sample sizes ranged from 29 participants to 2010 participants.

Table 4.2 Previous Studies of Smoking Cessation Intervention among Young Smokers

Authors	Interventions	Study design	Population	Location	Sample size
Buller et al. (2014)	Text messaging	Randomized trial	Young adult smokers (18-30 years old)	USA	102
Witkiewitz et al. (2014)	Mobile intervention	Randomized controlled trial	College student smokers also drink alcohol	USA	94
Shi et al. (2013)	Mobile phone text messaging	Randomized controlled trial	16-19 years old adolescent smokers	China	179
O'Neill et al. (2000)	Computer sessions (Messages)	Randomized controlled trial	18-25 years old young smokers	USA	65
Haug et al. (2009)	Short message service	Observational study	College smokers	Germany	194
Oermayer et al. (2004)	Cell phone text messaging	Observational study	18-25 years college student smokers	USA	46
Scherphof et al. (2014)	Nicotine patch	Randomized controlled trial	Aged 12-18 years student smokers	Netherlands	265
Rubinstein et al. (2008)	Nicotine nasal spray and counseling	Randomized controlled trial	Adolescent smokers (15-18)	USA	40
Roddy et al. (2006)	Nicotine patch and individual support	Randomized controlled trial	11-21 years old young smokers	UK	98
Killen et al. (2004)	Nicotine patch plus bupropion and nicotine	Randomized trial	Aged 15-18 years smokers	USA	211

	patch plus placebo				
Gray et al. (2011)	Varenicline and bupropion	Randomized trial	14-20 years old smokers	USA	29
Hanson et al. (2003)	Nicotine patch	Randomized controlled trial	Aged 13-19 years adolescent smokers	USA	100
Skov-Ettrup et al. (2014)	Website and tailored text messages	Randomized controlled trial	15-25 years old young smokers	Denmark	2010
Riley et al. (2008)	Internet and mobile phone text messaging	Observational study	18 to 24 college student smokers	USA	31
An et al. (2008)	RealU online cessation intervention	Randomized controlled trial	College smokers	USA	517
Prochaska et al. (2015)	Tailored, computer-assisted, brief counseling	Randomized controlled trial	13-25 years old young smokers	USA	60
Harris et al. (2010)	Motivational interviewing	Randomized controlled trial	18-22 years old young smokers	USA	452
Abroms et al. (2008)	In-person counseling, self-help kit, and tailored emails	Randomized controlled trial	18-23 years old young smokers	USA	83

Source: Author

4.2.4 Previous Studies of Cost-effectiveness Analysis in Smoking Cessation

There were two types of the previous studies of cost-effectiveness analysis in smoking cessation. Firstly, the researchers conducted an experiment and used the first hand data to assess the cost-effectiveness of smoking cessation intervention, for example, Secker-Walker et al. (2005) developed a quasi-experiment to estimate the cost-effectiveness of the project of women smoking cessation, and they presented that this project was more cost-effective compared to other interventions. Ruger et al. (2008) conducted a randomized controlled trial to analyze the cost-effectiveness of motivational interviewing for smoking cessation among low-income pregnant women in USA, and they found that the motivational interviewing was more costly and no more effective than usual care in boosting smoking cessation. Barnett et al. (2014) launched a randomized trial to examine the cost-effectiveness of extended smoking cessation for older smokers, and they discovered that the adding extended cognitive behavior therapy to standard cessation treatment was cost-effective.

Secondly, the researchers used the second hand data and applied the decision model to analyze the cost-effectiveness of smoking cessation intervention, for example, Wang et al. (2001) employed a decision analysis to evaluate the cost-effectiveness of Project Toward No Tobacco Use (TNT), and they presented that the TNT was extremely cost-effective compared to other widely accepted tobacco use prevention interventions. Song et al. (2002) applied a decision analysis to assess the cost-effectiveness of pharmacological interventions for smoking cessation, and they found that the adding NRT and bupropion to advice or counseling for smoking cessation was more cost-effective than other health care interventions. Shearer and Shanahan (2006) used an effectiveness dataset from international literature to analyze the cost-effectiveness of smoking cessation interventions in Australia, and they showed that the telephone counseling was the most cost-effective smoking cessation intervention. Pinget et al. (2007) conducted a Markov simulation model to estimate the cost-effectiveness of a smoking cessation counseling training program, and they uncovered that this program was a highly cost-effective.

4.2.5 Health Insurances and Smoking Cessation Interventions

Although smoking was a leading cause of 11.5% of global deaths (Reitsma et al., 2017), the health insurance coverage for smoking cessation interventions is infrequent, and the Medicaid of US is one of them. There were some researchers focused on the Medicaid and smoking cessation interventions, for example, Land et al. (2010) presented that among Massachusetts Medicaid beneficiaries, use of a comprehensive smoking cessation pharmacotherapy was related with a significant decrease in claims for hospitalizations for 46% of acute myocardial infarction and 49% other acute coronary heart disease. Liu (2009) found that the Medicaid coverage of tobacco dependence treatment had a positive impact on smoking cessation for women aged 18-44 years old. McMenamin et al. (2006) discovered that the perceived effectiveness of tobacco dependence treatments was positively associated with the use of it in the Medicaid, but a majority of the Medicaid smokers did not know that the Medicaid covered tobacco dependence treatments. Petersen et al. (2006) showed that higher levels of coverage during prenatal care for smoking cessation services in the Medicaid were related with higher smoking quit rates.

Moreover, Chevreul et al. (2012) revealed that the cost-effectiveness of full coverage of the medical management of smoking cessation from €1786 to €2012 in the statutory health insurance of France, which was the most cost-effective approach compared to the other primary and secondary prevention programs. Curry et al. (1998) conducted a longitudinal natural experiment for four insurance plans in a health maintenance organization of US and found that the 2.4% of smokers who were with reduced coverage used smoking cessation services, and the 0.7% of them quit smoking. However, the rate of use of smoking cessation services was 10% among the smokers with full coverage, and the 2.8% of them quit smoking.

4.3 Methods

4.3.1 Study Design

The present study conducted a single blind, three-group randomized, controlled trial comparing the nicotine replacement therapy (NRT) with the mobile phone text messaging plus group behavior therapy (TM plus GBT) aimed at promoting abstinence from smoking (See Figure 4.1). Participants' responses were assessed at baseline, 4 weeks and 3 months after the smoking cessation interventions.

Figure 4.1 Study Design
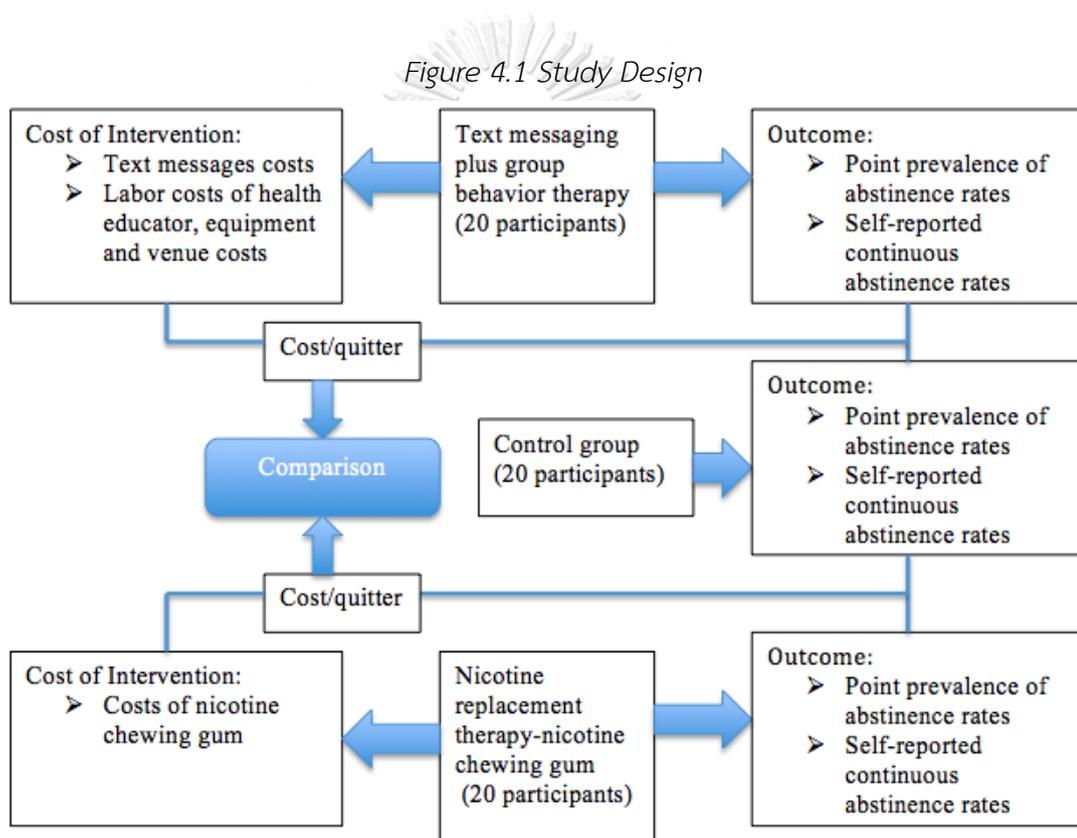
Source: Author

4.3.2 Approvals Obtained

The Ethics Committee of Inner Mongolia Medical University approved the ethical certificate (YKD2015008).

4.3.3 Fund

The trial was funded from the Research Institute for Health Policy of Inner Mongolia (100,000 Bath) and the 90th Anniversary of Chulalongkorn University Scholarship (132,000 Bath).

4.3.4 Trial Site

The present study was conducted in Jinshan Campus, Hohhot, Inner Mongolia Medical University, Hohhot, Inner Mongolia, China.

4.3.5 Sample Size

Messer et al. (2008) found that among recent dependent smokers who were 18-24 years olds and attended college, there was a smoking cessation rate of 34.8%. Bian et al. (2012) conducted a questionnaire survey in Inner Mongolia Medical University, and they discovered that 61.3% daily smokers smoked less than 5 cigarettes per day, 63.8% daily smokers started to smoke since high school, and 15.2% daily smokers since university. Based on above information, this study assumed that a smoking cessation rate was 34% for the calculation of sample size.

This study recruited 10% more subjects to allow for dropouts, so the final sample size was 26 (23+23*0.1) participants in each group and total sample size was 78 participants (See Table 4.3).

Table4.3 Calculation of Sample Size

NRT plus counseling versus counseling	
Two-sided significance level (1-alpha %)	90
Power (1-bta, %)	80
Ratio of sample size, Unexposed/Exposed[1]	1

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1 Ratio of sample size: for equal samples, use 1.

	Kelsey method2	Fleiss method3
Percent of unexposed with outcome		5
Percent of exposed with outcome		34
Odds Ratio		9.8
Sample size- TM plus GBT	24	23
Sample size- NRT	24	23
Sample size- no intervention	24	23
Total sample size	72	69

Source: Author

4.3.6 Participant Eligibility

Inclusion criteria were as follows: (1) At least 18 years old and a current college student; (2) Willing to quit smoking; (3) Self-report smoking cigarettes daily (self-report smoking at least 1 cigarette per day); (4) No current use of smoking cessation services in past months. (5) No major physical health problems. (6) Own mobile phone in the TM plus GBT group.

4.3.7 Identifying Participants

This study used two ways to recruit participants: (1) referral from staff of student affairs, (2) smoker self-referral.

Referral from staff of student affairs: Staff of student affairs are in charge of the management of students, and they know the personal lives of students and which one smoke. The staff of student affair encouraged the smoking students to join the trial and to provide the contact information to the study researchers.

Smoker self-referral: Poster advertisements of the trial were widely displayed in the information bar of Jinshan campus, Inner Mongolia Medical University. The

2 Base on Kelsey (1996) Method in observational epidemiology, Table 12-15.

3 Base on Fleiss (2013) Statistical methods for rates and proportions, formulas 3.18 and 3.19.

posters invited smokers to contact the study researchers if they were willing to join the trial.

4.3.8 Screening for Eligibility

The study staff contacted potential participants by telephone and made appointments with them. The staff briefly explained the trial and asked the questions face to face, specifically: (1) How old are you? (2) Do you smoke daily? (3) How much do you smoke per day? (4) Do you use smoking cessation services now? (5) Do you have major physical health problems? (6) Do you want to quit smoking and join our trial? Based on their answers to the questions, the potential participants who met the inclusion criteria joined this trial.

The participants provided written informed consent before the randomization. Of 68 college-aged smokers referred, 8 refused to participate, and 60 were enrolled.

4.3.9 Baseline Assessment

When the participants provided the informed consent, they completed the baseline questionnaires. Table 4.4 presents the characteristics of the participants in the trial.

Table 4.4 Characteristics of Participants

Variable		Percentage/Mean
Gender	Male	100.00
	Female	0.00
Mean age (years)		19.97
Place of Residence	Urban	46.67
	Rural	53.33
Ethnicity	Minority	26.67
	Han	73.33

Mean years of smoking	3.52
Mean number of cigarettes smoked	6.55
Health related quality of life	0.85
FTND score	1.45

Source: Author

4.3.10 Randomization

The current study randomized the participants to the TM plus GBT group, the NRT group, and the control group. Simple randomization was used following a computer-generated random number sequence (See Table 4.5).

Table 4.5 Result of Simple Randomization

TM plus GBT group (20)	NRT group (20)	Control group (20)
3, 4, 6, 7, 8, 11, 13, 18, 21, 36, 37, 42, 45, 47, 48, 52, 53, 54, 55, 58	2, 5, 10, 15, 16, 17, 19, 20, 24, 26, 30, 31, 32, 33, 34, 38, 43, 46, 51, 57	1, 9, 12, 14, 22, 23, 25, 27, 28, 29, 35, 39, 40, 41, 44, 49, 50, 56, 59, 60

Source: Author

4.3.11 Interventions

4.3.11.1 Control Group

The participants allocated to the control group were asked to attend one-hour brief intervention session, and received brief information of health damage caused by smoking by a study staff.

The current study provided limited information of health damage caused by smoking to the participants in the control group, and the participants were informed

the quit day of smoking (07/12/2017). Therefore, the control group in this trial is not a regular control group.

4.3.11.2 Intervention Groups

The current study conducted two kinds of interventions. They were TM plus GBT and NRT (nicotine chewing gum), respectively. All participants in intervention groups reached a consensus: the first day of the intervention (07/12/2017) would be the quit day of smoking. In order to avoid the issue of contamination between the intervention groups, this study asked the participants in the NRT group not to share their nicotine gums to other smokers, and the participants in the TM plus GBT group were not allowed to spread the knowledge of smoking cessation. The details of the interventions are as follows:

1 TM plus GBT

The participants in the TM plus GBT group received two text messages a day for 4 weeks. The reasons of employing mobile phone text messaging are as follows: firstly, text messaging is the basic function of mobile phone, so the participants can receive the messages and do not need to install extra instant-messaging software. Secondly, text messaging is often used to send official notification, so the participants may pay more attention the content of messages.

These messages were excerpted from the WeChat official account of Beijing Chao-Yang Hospital of Capital Medical University, which has been the World Health Organization Collaborating Center for Tobacco or Health since 1986. The content of messages included: health damage caused by smoking, health benefit of stopping smoking, reasonable attitudes towards smoking, how to get started on stopping smoking, useful skills to stopping smoking, and how to refuse a cigarette and avoid relapse.

Additionally, the TM plus GBT group provided group behavior therapy for smoking cessation. The participants received some form of behavioral intervention such as information, advice and encouragement from a professional health educator, delivered in two sessions (3 hours per session) in the first week.

2 NRT

The participants in the NRT group received 2-mg nicotine gum and instruction for the nicotine gum (Nicorette Coolmint 2 mg gum). The reasons of using nicotine gum are as follows: firstly, there are six different types of NRT in the world (nicotine patch, nasal spray, gum, lozenge, inhaler, and sublingual tablet), but only the nicotine patch and gum are available in China. Secondly, college-aged adults using nicotine patch is less convenient compared with using nicotine gum.

Table 4.6 shows the instruction of the nicotine gum based on the Chinese clinical guidelines for smoking cessation.

Table 4.6 Instruction of the Nicotine Gum

Qualitative and quantitative composition	Containing 2 mg nicotine, as nicotine resinate
Attentions	Not recommended for people: Less than 18 years old Smoked less than 10 cigarettes per day Pregnant or breast feeding women Acute myocardial infarction within 2 weeks Severe arrhythmia Unstable angina pectoris Poor hypertension control
Dosage	Use the gum according to the following 12 weeks • Week 1 to 6: 1 piece every 1 to 2 hours (8-12 piece per day) • Week 7 to 8: 1 piece every 2 to 4 hours (4-8 piece per day) • Week 9 to 12: 1 piece every 4 to 8 hours (2-4 piece per day)
Direction	• Chew the gum slowly until you can taste the nicotine or feel a tingling.

- Stop chewing and park the piece of gum between cheek and gums.

- After about a minute, the tingling is almost gone, and chews the gum again.

- Repeat this process (about 30 minutes)

More common:

- Mouth sores, blisters, or irritation

- Nausea or vomiting

- Sore throat

Less common:

Side effects

- Acid or sour stomach

- Belching, diarrhea, dizziness, heartburn, and hiccups

- Mouth, tooth, jaw or neck pain

- Problems with teeth

- Unusual tiredness or weakness

Source: Author

The participants were instructed to use the gum whenever they had an urge to smoke and to chew between 2 and 4 pieces daily (1 piece every 4 to 8 hours). The nicotine gum was used as desired for up to 4 weeks, so the participants in the NRT group received 112 pieces of nicotine chewing gums in total. The main reasons why are as follows: Firstly, Table 4 presents that the participants in this study averaged 19.97 year of age and were current college students. These college students represent a transitional development between adolescence and adulthood, and these college-aged adult smokers are more similar to adolescent smokers than to older smokers (Oermayer et al., 2004). Secondly, Table 4 shows that for all participants, the average number of cigarettes smoked were 6.55 less than 10 cigarettes per day. Table 4 indicates that the FTND score of the participants were 1.45, so all participants were

low-level nicotine dependence. Based on the above three points, the nicotine chewing gum should be used with caution among the college-aged smokers. This study assumed that the college-aged smokers stepped over the first two stages of using nicotine gum, and all participants in the NRT group started chewing nicotine gum from the third stage, namely, chewing 2 and 4 pieces daily.

4.3.12 Follow-ups

The follow-ups were conducted twice: the first time was 4 weeks after the intervention and the other is 3 months after the intervention. Baseline assessments were launched face to face, while after 4 weeks and 3 months, the follow-ups were carried out by online questionnaires.

4.3.13 Outcome Measurement

4.3.13.1 Primary Outcomes

Continuous abstinence rate means the percentage of former smokers who have not smoked at all since the quit day. This study calculated the continuous abstinence rates at 4 weeks follow-up and 3 months follow-up based on the participants self-reported answers.

4.3.13.2 Secondary Outcomes

The point prevalence of abstinence rate means the percentage of former smokers who are not smoking at a particular point in time. The minimum periods of abstinence used for point prevalence rates are at 24 hours, 7 days, and 30 days. This study used 7 days as the minimum period of abstinence and calculated the point prevalence of abstinence rates at 4 weeks and at 3 months based on the participants self-reported answers.

4.3.14 Costs

A smoking cessation service provider's perspective was taken, and this study only included intervention costs, which consisted of all costs that could be attributed to the delivery of the interventions, such as venue, equipment (projector, computer, and microphone and so on), a health educator, text messages, and nicotine chewing gum (See Table 4.7). Labor costs of the study staff (collection of data, management of the intervention, and sending text messages and so on) in the progress of intervention and in control group were excluded. The intervention occurred within 4 weeks, and the costs were not discounted. All the costs were converted to US dollars using the exchange rate (1 US dollar is equal to RMB 6.62 Yuan[4]) on the first day of intervention (07/12/2017).

Table 4.7 Details of Interventions Costs

Intervention	Description	Costs	Timing
TM plus GBT	Text messages: two text messages a day for 4 weeks	Text messages cost	Week 1, 2, 3, and 4.
TM plus GBT	Group behavior therapy: two sessions, 3 hours per session, a health educator provided information, advice and encouragement to the smokers.	Personal cost of health educator, rent equipment cost and venue cost	Week 1
NRT	Nicotine chewing gum: 2-mg nicotine gum, 112 pieces (4 pieces * 28 days) per smoker.	Cost of nicotine chewing gum	Week 1, 2, 3, and 4.

Source: Author

4.3.14.1 Text Messaging Cost

The current study employed the text messaging services of the China Unicom, and the cost of messaging was RMB 0.1 Yuan or 0.015 USD each text.

4.3.14.2 Personal Cost

The personal cost was calculated in term of hourly compensation (salary and fringe benefits). The professional health educator in this study has a Master's degree of clinical medicine and works at the Inner Mongolia Institute of Health Sciences Education as an associate professor. According to the requirement of the administrative measures of training expense among party and government offices in Inner Mongolia, the associate professor received the training fee that was RMB 1000 Yuan for 6 hours, or RMB 166.7 Yuan or 25.18 USD per hour.

4.3.14.3 Equipment and Venue Costs

The costs of equipment and venue were impossible to estimate, because this study used multimedia classroom in Inner Mongolia Medical University. This study employed a proxy cost, and assumed that we rented a same size equipped conference room for 3 hours in the Hohhot of Inner Mongolia. The rental fees of conference room would be the costs of equipment and venue in this study, and the total amount of rent was RMB1600 Yuan per 12 hours on average, or RMB 133.3 Yuan or 20.14 USD per hour.

4.3.14.4 Nicotine Chewing Gum Cost

The study used the retail price of the nicotine chewing gum. The price of Nicorette Coolmint 2mg gum per box (105 pieces gum per box) was RMB 156 Yuan, or one piece of gum's cost was RMB 1.5 Yuan or 0.23 USD.

4.3.15 Cost-effectiveness Analysis

Firstly, this study calculated the intervention costs of TM plus GBT and NRT per person (See Equations 5.1-5.3). Secondly, this study counted the outcomes of the TM plus GBT group, the NRT group, and the control group (See Equations 5.4-5.9). Finally, this study computed the incremental cost-effectiveness ratios (ICER) of both interventions: the TM plus GBT group vs. the control group and the NRT group vs. the control group (See Equations 5.10-5.13).

$$Cost\ per\ person_{Control\ group} = 0 \quad (5.1)$$

$$Cost\ per\ person_{TM\ plus\ GBT\ group} = \frac{Total\ Cost\ of\ TM\ plus\ GBT}{20} \quad (5.2)$$

$$Cost\ per\ person_{NRT\ group} = \frac{Total\ Cost\ of\ NRT}{20} \quad (5.3)$$

$$Continuous\ abstinence\ rate_{Control\ group} =$$
$$\frac{The\ number\ of\ participants\ who\ have\ not\ smoked\ at\ all\ since\ the\ quit\ day\ in\ control\ group}{20} \quad (5.4)$$

$$Continuous\ abstinence\ rate_{TM\ plus\ GBT\ group} =$$
$$\frac{The\ number\ of\ participants\ who\ have\ not\ smoked\ at\ all\ since\ the\ quit\ day\ in\ TM\ plus\ GBT\ group}{20} \quad (5.5)$$

$$Continuous\ abstinence\ rate_{NRT\ group} =$$
$$\frac{The\ number\ of\ participants\ who\ have\ not\ smoked\ at\ all\ since\ the\ quit\ day\ in\ NRT\ group}{20} \quad (5.6)$$

$$Point\ prevalence\ of\ abstinence\ rate_{Control\ group} =$$
$$\frac{The\ number\ of\ participants\ who\ are\ not\ smoking\ at\ particular\ point\ in\ time\ in\ control\ group}{20} \quad (5.7)$$

$$Point\ prevalence\ of\ abstinence\ rate_{TM\ plus\ GBT\ group} =$$
$$\frac{The\ number\ of\ participants\ who\ are\ not\ smoking\ at\ particular\ point\ in\ time\ in\ TM\ plus\ GBT\ group}{20} \quad (5.8)$$

$$Point\ prevalence\ of\ abstinence\ rate_{NRT\ group} =$$
$$\frac{The\ number\ of\ participants\ who\ are\ not\ smoking\ at\ particular\ point\ in\ time\ in\ NRT\ group}{20} \quad (5.9)$$

$$ICER_{TM\ plus\ GBT\ vs.control1} =$$
$$\frac{Cost\ per\ person_{TM\ plus\ GBT\ group} - Cost\ per\ person_{Control\ group}}{Continuous\ abstinence\ rates_{TM\ plus\ GBT\ group} - Continuous\ abstinence\ rates_{Control\ group}} \quad (5.10)$$

$$ICER_{NRT\ vs.control1} = \frac{Cost\ per\ person_{NRT\ group} - Cost\ per\ person_{Control\ group}}{Continuous\ abstinence\ rates_{NRT\ group} - Continuous\ abstinence\ rates_{Control\ group}} \quad (5.11)$$

$$ICER_{TM\ plus\ GBT\ vs.control2} =$$
$$\frac{Cost\ per\ person_{TM\ plus\ GBT\ group} - Cost\ per\ person_{Control\ group}}{Point\ prevalence\ of\ abstinence\ rates_{TM\ plus\ GBT\ group} - Point\ prevalence\ of\ abstinence\ rates_{Control\ group}} \quad (5.12)$$

$$ICER_{NRT\,vs.control2} =$$
$$\frac{Cost\,per\,person_{NRT\,group} - Cost\,per\,person_{Control\,group}}{Point\,prevalence\,of\,abstinence\,rates_{NRT\,group} - Point\,prevalence\,of\,abstinence\,rates_{Control\,group}} \quad (5.13)$$

4.3.16 Sensitivity Analysis

This study performed the one-way sensitivity analysis to examine the robustness of the incremental cost-effectiveness ratios. The effectiveness and costs values may be of interest as follows: the effectiveness of TM plus GBT based on the continuous abstinence rate, the effectiveness of NRT based on the continuous abstinence rate, the cost of the TM plus GBT per person, and the cost of the NRT per person.

4.4 Results

4.4.1 Baseline Characteristics

Table 4.8 shows the baseline characteristics for 60 participants. The TM plus GBT group, the NRT group, and the control group are comparable at baseline in terms of age, the place of residence, ethnicity, the years of smoking, the number of cigarettes smoked, the health related quality of life, FTND score, height, and weight.

The participants average 20.15 years of age in the TM plus GBT group, 19.70 years of age in the NRT group, and 20.05 years of age in the control group. They have smoked an average 3.13 years with 6.25 cigarettes per day in the TM plus GBT group. The indicators in the NRT group and the control group are 3.93 years with 7.35 cigarettes and 3.50 years with 6.05 cigarettes, respectively. The average scores of FTND are 1.40 in the TM plus GBT group, 1.70 in the NRT group, and 1.25 in the control group. These statistics imply that the participants averagely had a low dependence on nicotine in the three groups.

Table 4.8 Baseline Characteristics of Participants in TM plus GBT Group, NRT Group,
and Control Group

	College-aged adults, n (%) and mean [SD]		
	TM plus GBT group	NRT group	Control group
Age	20.15 [1.23]	19.70 [1.30]	20.05 [1.96]
Place of residence: rural	10 (50.00)	11 (55.00)	11 (55.00)
Ethnicity: minority	4 (20.00)	7 (35.00)	5 (25.00)
Years of smoking	3.13 [2.24]	3.93 [2.46]	3.50 [1.88]
Number of cigarettes smoked	6.25 [4.88]	7.35 [5.83]	6.05 [3.46]
Health related quality of life	0.84 [0.12]	0.85 [0.12]	0.87 [0.09]
FTND score	1.40 [1.70]	1.70 [1.84]	1.25 [1.45]
Height (cm)	177.65 [4.31]	174.25 [5.04]	174.15 [5.19]
Weight (kg)	70.28 [13.24]	65.73 [9.64]	64.60 [8.28]

Source: Author

4.4.2 Costs Findings

Table 4.9 reports the costs of the smoking cessation interventions in the TM plus GBT group and the NRT group. The cost of TM plus GBT is $288.72, which consists of the text messaging cost ($16.80), the personal cost ($151.08), and the equipment and venue cost ($120.84). The total cost of the NRT equals the nicotine chewing gum cost that is $515.20. There were 40 participants who are evenly distributed in the TM plus GBT group and the NRT group, so the costs per person are $14.44 in the TM plus GBT group and $25.76 in the NRT group, respectively.

Table 4.9 Costs of Smoking Cessation Intervention in TM plus GBT Group and NRT Group

	Text messaging cost	Personal cost	Equipment and venue cost	Nicotine chewing gum cost	Total costs	Cost per person
TM plus GBT group	16.80	151.08	120.84	-	288.72	14.44
NRT group	-	-	-	515.20	515.20	25.76
Control group	-	-	-	-	0	0

Source: Author

4.4.3 Effectiveness Findings

Table 4.10 presents the effectiveness of the smoking cessation interventions at 4 weeks follow-up in the TM plus GBT group, the NRT group, and the control group. The participants in the TM plus GBT group and the NRT group have the same continuous abstinences rates (0.30) at 4 weeks follow-up. Additionally, the participants in the NRT group have the highest point prevalence of abstinence rate (0.50) at 4 weeks follow-up.

Table 4.10 Effectiveness of Smoking Cessation Intervention at 4 Weeks Follow-up in TM plus GBT Group, NRT Group, and Control Group

The number of participants who have not smoked at all since quit day at 4 weeks	Continuous abstinence rate	The number of participants who are not smoking at the end of the forth week	Point prevalence of abstinence rate

	The number of participants who have not smoked at all since quit day at 3 months	Continuous abstinence rates	The number of participants who are not smoking at the end of the 3 months	Point prevalence of abstinence rates
TM plus GBT group	6	0.30	7	0.35
NRT group	6	0.30	10	0.50
Control group	1	0.05	6	0.30

Source: Author

Table 4.11 presents the effectiveness of the smoking cessation intervention at 3 months follow-up in the TM plus GBT group, the NRT group, and the control group. The participants in the TM plus GBT group have a much higher continuous abstinence rates (0.25) compared to the participants in the NRT group (0.15) at 3 months follow-up. Moreover, the participants in the NRT group have the highest point prevalence of abstinence rate (0.55) at 3 months follow-up.

Table 4.11 Effectiveness of Smoking Cessation Intervention at 3 Months Follow-up in TM plus GBT Group, NRT Group, and Control Group

	The number of participants who have not smoked at all since quit day at 3 months	Continuous abstinence rates	The number of participants who are not smoking at the end of the 3 months	Point prevalence of abstinence rates
TM plus GBT group	5	0.25	8	0.40
NRT group	3	0.15	11	0.55
Control group	1	0.05	7	0.35

Source: Author

4.4.4 Cost-effectiveness Findings

Table 4.12 shows the results of the incremental cost per quitter based on the continuous abstinence rate at 4 weeks follow-up. The TM plus GBT is compared to the no intervention for an incremental cost per quitter of $57.76, and the NRT is compared to no intervention for a higher incremental cost per quitter of $103.04. These statistics imply that the TM plus GBT was more cost-effective than the NRT based on the continuous abstinence rate at 4 weeks follow-up.

Table 4.12 Incremental Cost Per Quitter Based on Continuous Abstinence Rate at 4 Weeks Follow-up

	Cost (Per person)	Effectiveness (Continuous abstinence)	Incremental cost	Incremental effectiveness	Incremental cost/quitter
Control group: no intervention	0	0.05	-	-	-
TM plus GBT group	14.44	0.30	14.44	0.25	57.76
NRT group	25.76	0.30	25.76	0.25	103.04

Source: Author

Table 4.13 presents the results of the incremental cost per quitter based on the continuous abstinence rate at 3 months follow-up. Compared to no intervention, the incremental cost per quitter for the TM plus GBT is $72.20. The NRT is compared to no intervention for a much higher incremental cost per quitter of $257.60. These statistics imply that the TM plus GBT was also more cost-effective than the NRT based on the continuous abstinence rate at 3 months follow-up.

Table 4.13 Incremental Cost Per Quitter Based on Continuous Abstinence Rate at 3 Months Follow-up

	Cost (Per person)	Effectiveness (Continuous abstinence)	Incremental cost	Incremental effectiveness	Incremental cost/quitter
Control group: no intervention	0	0.05	-	-	-
TM plus GBT group	14.44	0.25	14.44	0.20	72.20
NRT group	25.76	0.15	25.76	0.10	257.60

Source: Author

Table 4.14 shows the results of the incremental cost per quitter based on the point prevalence of abstinence at 4 weeks follow-up. The NRT is compared to the no intervention for an incremental cost per quitter of $128.80, and the TM plus GBT is compared to no intervention for a higher incremental cost per quitter of $288.80. These statistics imply that the NRT was thus more cost-effective than the TM plus GBT based on the point prevalence of abstinence rate at 4 weeks follow-up.

Table 4.14 Incremental Cost Per Quitter Based on Point Prevalence of Abstinence Rate at 4 Weeks Follow-up

	Cost (Per person)	Effectiveness (Point prevalence of abstinence)	Incremental cost	Incremental effectiveness	Incremental cost/quitter
Control group: no intervention	$0	0.30	-	-	-
TM plus GBT	14.44	0.35	16.58	0.05	288.80
NRT	25.76	0.50	26.21	0.20	128.80

Source: Author

Table 4.15 shows the results of the incremental cost per quitter based on the point prevalence of abstinence at 3 months follow-up. The incremental costs per quitter are the same at 3 months follow-up and 4 weeks follow-up due to the incremental effectiveness were no change. These statistics imply that the NRT was thus more cost-effective than the TM plus GBT based on the point prevalence of abstinence rate at 3 months follow-up.

Table 4.15 Incremental Cost Per Quitter Based on Point Prevalence of Abstinence Rate at 3 Months Follow-up

	Cost (Per person)	Effectiveness (Point prevalence of abstinence)	Incremental cost	Incremental effectiveness	Incremental cost/quitter
Control group: no intervention	0	0.35	-	-	-
TM plus GBT group	14.44	0.40	14.44	0.05	288.80
NRT group	25.76	0.55	25.76	0.20	128.80

Source: Author

4.4.5 One-way Sensitivity Analysis Findings

Table 4.16 indicates the results of one-way sensitivity based on the continuous abstinence rate at 3 months follow-up. Firstly, the effectiveness measured the number of participants who have not smoked at all since the quit day vary from 2 to 15 per 20 participants. Secondly, the costs of the TM plus GBT per person vary from $7.22 to $57.76. Thirdly, the costs of the NRT range from $2.58 to $23.18 per person.

Table 4.16 One-way Sensitivity Analysis Based on Continuous Abstinence Rate at 3 Months Follow-up

Parameter varied	Incremental cost-effectiveness (Continuous abstinence)	
	TM plus GBT	NRT
Baseline	257.60	72.20
Effectiveness of TM plus GBT (baseline 5/20)		
15/20	20.63	
10/20	32.09	
9/20	36.10	
8/20	41.26	
7/20	48.13	
6/20	57.76	
4/20	96.27	
3/20	144.40	
2/20	288.80	
Effectiveness of NRT (baseline 3/20)		
15/20		36.80
10/20		57.24

9/20	64.40
8/20	73.60
7/20	85.87
6/20	103.04
5/20	128.80
4/20	171.73
2/20	515.20

Cost of TM plus GBT per person (baseline $14.44)

57.76	288.80
43.32	216.60
28.88	144.40
13.00	64.98
11.55	57.76
10.11	50.54
8.66	43.32
7.22	36.10

Cost of NRT per person (baseline $25.76)

23.18	231.84

20.61	106.08
18.03	180.32
15.46	154.56
12.88	128.80
7.73	77.28
5.15	51.52
2.58	25.75

Source: Author

In order to better compare the two smoking cessation interventions, this study used the tornado diagrams to present the one-way sensitivity analysis (See Figures 4.2-4.5).

Figure 4.2 and Figure 4.3 show the results of one-way sensitivity analysis based on the change of the effectiveness of the TM plus GBT and the NRT. Because the TM plus GBT dominates the NRT in the base case ($72.20 per quitter vs. $257.60 per quitter), this study explored the implications of lowering the effectiveness of the TM plus GBT on the incremental cost per quitter. Decreasing the quit rate by 0.10 let the TM plus GBT is dominated by the NRT, with an incremental cost per quitter of $288.80. Moreover, this study attempted to the implications of improving the effectiveness of the NRT on the incremental cost per quitter. Increasing the quit rate by 0.40 almost eliminate the TM plus GBT domination of the NRT, with an incremental cost per quitter of $73.60.

Figure 4.2 One-way Sensitivity Analysis Based on the Change of Effectiveness of TM plus GBT
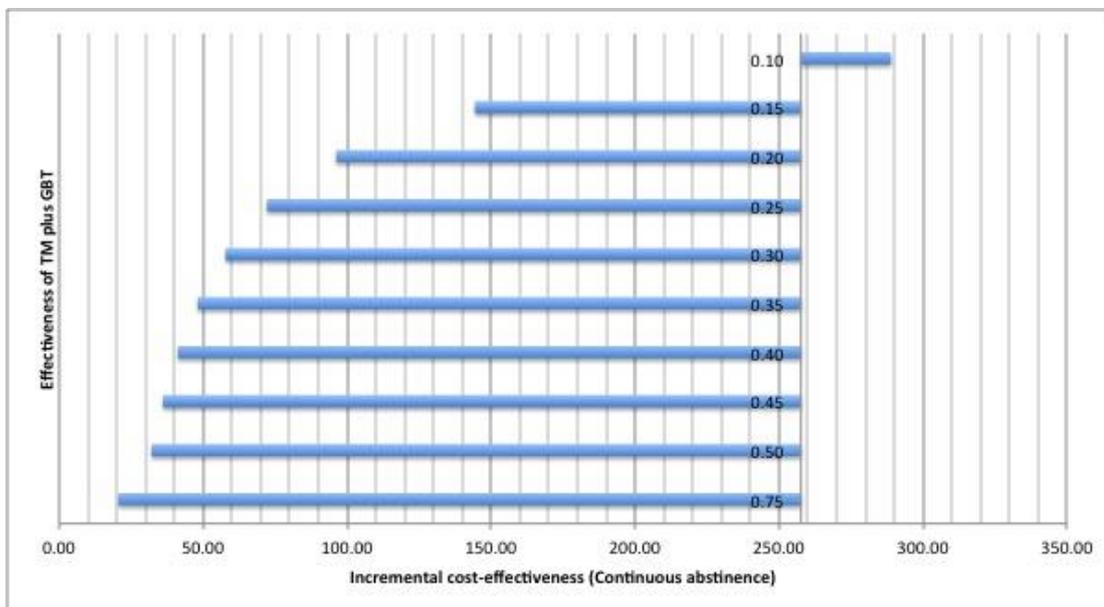
Source: Author

Figure 4.3 One-way Sensitivity Analysis Based on the Change of Effectiveness of NRT
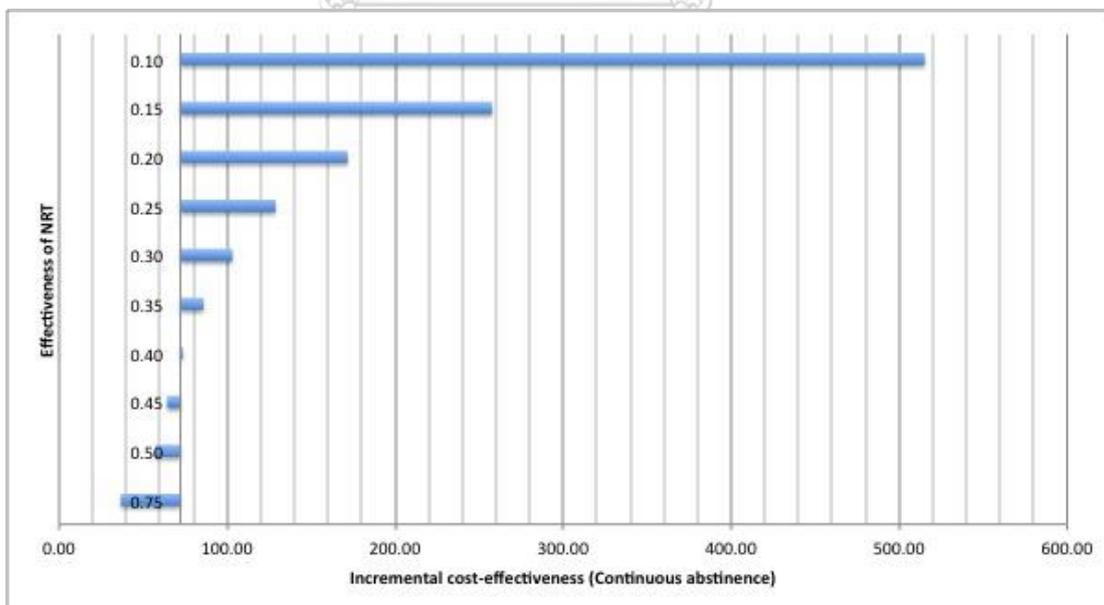
Source: Author

Figure 4.4 and Figure 4.5 show the results of one-way sensitivity analysis based on the change of the cost of the TM plus GBT per person and the cost of the NRT per person. In the base case, the TM plus GBT is favorable than the NRT in term of the incremental costs per quitter ($72.20 vs. $257.60), so this study explored the implications of improving the cost of the TM plus GBT on the incremental cost per quitter. Increasing the cost by $57.76 eliminate the TM plus GBT domination of the NRT, with an incremental cost per quitter of $288.80. Moreover, this study attempted to the implications of lowering the cost of the NRT on the incremental cost per quitter. Decreasing the cost by 5.15 let the TM plus GBT is dominated by the NRT, with an incremental cost per quitter of $51.25.

Figure 4.4 One-way Sensitivity Analysis Based on the Change of Cost of TM plus GBT Per Person
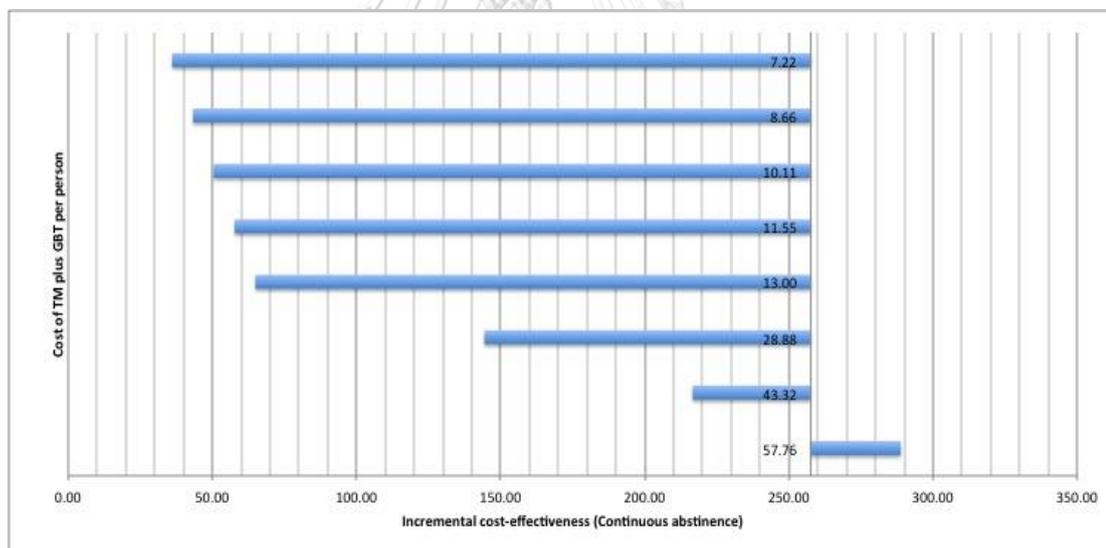
Source: Author

Figure 4.5 One-way Sensitivity Analysis Based on the Change of Cost of NRT Per Person
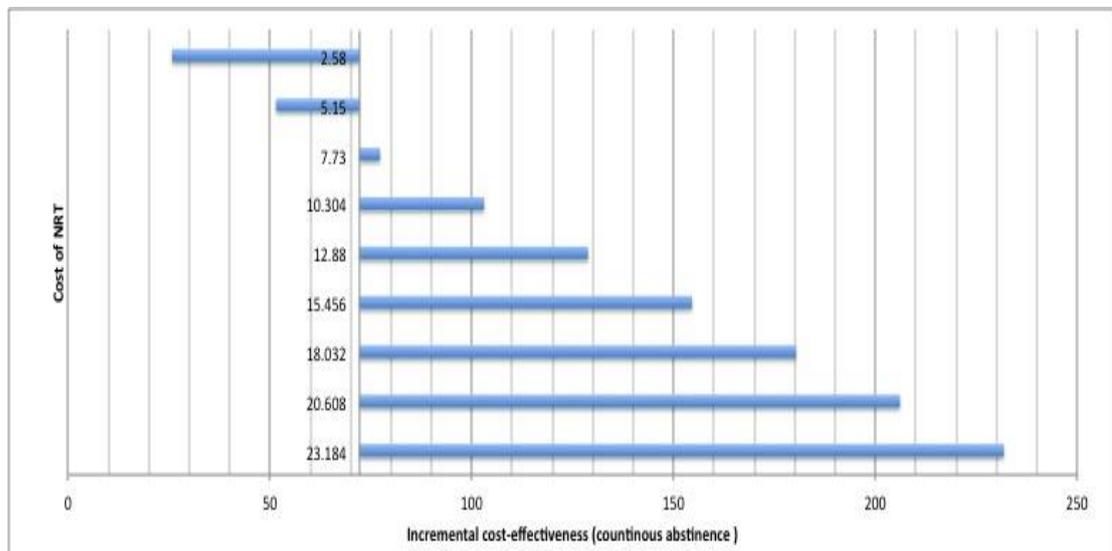
Source: Author

4.5 Discussions

This study analyzed the economic implications of two smoking cessation interventions, the TM plus GBT and the NRT. The cost-effectiveness of the TM plus GBT for smoking cessation compared to the NRT were estimated to be $72.20 per quitter and $257.60 per quitter, which used the continuous abstinence rate as effectiveness measurement at 3 months follow-up. When the point prevalence of abstinence was considered as the effectiveness, the NRT cost was more than the TM plus GBT but provided the additional effectiveness, which were estimated to be $128.80 per quitter for the NRT and $288.80 per quitter for the TM plus GBT.

Velicer et al. (1992) assessed the outcome in smoking cessation studies, and introduced the continuous abstinence rate and the point prevalence of abstinence rate in detail. The continuous abstinence rate can be highly stable over time and is more appropriate for evaluating the long-term health effects of smoking cessation, but it is only a small number of smokers actually change from smoking to non-smoking without relapses. For the point prevalence of abstinence rate, it can include delayed smoker quitters and captured the dynamic process of quitting, but it may overestimate

the number of short-term quitters. The objective of this study was to propose the most cost-effectiveness smoking cessation intervention into the BMIURR package in Inner Mongolia, China. When the BMIURR decides whether to adopt the smoking cessation intervention, of courses it expects that the effectiveness of the smoking cessation intervention can be stable over time and is benefit for long-term health, which can reduce the utilization of health care and the health expenditure related to smoking. Based on the above considerations, this study preferred the continuous abstinence rate as effectiveness measurement, and it presented that the TM plus GBT was more cost-effective compared to the NRT ate 3 months follow-up.

There were several limitations of the present study. Firstly, according to the calculation of sample size, this study should recruit 78 participants. Because some college smokers did not want to join this experiment, epically female college smokers, the current study finally recruited 60 participants who were all male college smokers. Secondly, almost all participants were recommended from the staff of student affairs. Because the participants respect and afraid of these staff, it may increase the adherence of participants to smoking cessation intervention, and then influenced the abstinence outcomes. Thirdly, the measurement of effectiveness was self-report answers and it was unclear to what extent self-report smoking matched the actual smoking among participants, so it may occur under- or over reporting smoking abstinence rates without the biochemical measures (Patrick et al., 1994). Fourthly, the current study just brief surveyed how many nicotine gums did use by the participants in NRT group (1.98 pieces per day). However, there was no measure of whether the participants in the TM plus GBT group paid attention to the text messages and the group therapy. Fifthly, this study assessed the smoking cessation interventions on just one university with an undergraduate population. Follow-up studies should involve multiple universities or extend the college students to other young people that would be of great interest. Finally, the limitation was that the 3 months follow-up was possibly too brief to assess the effectiveness of the smoking cessation interventions. To deal with this problem, this study planned to collect the effectiveness data after 6 months follow-up and 1-year follow-up, and evaluated the lasting impact of interventions on smoking cessation.

Chapter V

Conclusions and Policy implications

5.1 Conclusions

This dissertation focused on tobacco use, health care utilization, household expenditure, self-rated health, and smoking cessation interventions in rural China. It includes three topics, and the details are as follows:

Topic #1 The Impact of Cigarette Smoking on Health Care Utilization among Rural Residents in China: (1) To assess how smoking affects health care utilization among rural residents in China, this study used the fixed effect and random effect logistic models based on three waves the CFPS panel data. (2) To analyze the choice of health facility among current and former smokers in rural China, this study conducted the multinomial logistic model based on the third wave of CFPS.

Topic #2 The Impact of Tobacco Consumption on Rural Household Expenditure and Self-rated Health Among Rural Household Members in China: (1) To estimate how tobacco consumption affects household expenditure on other goods and services in rural China, the present study employed the seemingly unrelated regression based on three waves the CFPS panel data. (2) To assess the impact of tobacco consumption to self-rated health among rural household members in China, the present study used the random effects generalized ordered probit model based on three waves the CFPS panel data.

Topic #3 Cost-Effectiveness of the Smoking Cessation Interventions Among college-aged Adults in Inner Mongolia, China: (1) The current study conducted the randomized controlled trial in Inner Mongolia Medical University, China, and collected first hand data. (2) To analyze the most cost-effectiveness smoking cessation intervention for college-aged adults in Inner Mongolia, China, the current study used the cost-effectiveness analysis based on the first hand data. (3) To propose the most cost-effectiveness smoking cessation intervention into the BMIURR package in Inner Mongolia, China.

5.1.1 Tobacco Use and Health Care Utilization

The key findings are summarized from Topic #1 as follows: Firstly, current and former smokers used more outpatient care than non-smokers, and former smokers used more inpatient care than non-smokers in rural China. Secondly, long-term quitters decreased the probability of using inpatient care compared to recent and moderate-term quitters in rural China. Thirdly, recent and long-term quitters had a much higher probability of visiting the general and specialized hospital compared to vising the village health center and the clinic in rural China. Fourthly, heavy smokers were negatively associated with visiting the general hospital and the village health center compared with the clinic in rural China.

In summary, current and former smokers utilize more health care than non-smokers in rural China, and smokers are significantly predicted to higher health care costs. These costs are mostly covered by rural medical insurance and add a great burden to the government of rural China.

5.1.2 Tobacco Consumption, Household Expenditure, and Self-rated Health

The key findings are summarized from Topic #2 as follows: Firstly, tobacco consumption crowded out expenditures on food, dress, health care, and education for rural households in China. Moreover, high tobacco consumption households reduced much more spending on health care and education compared with other tobacco consumption households in rural China. Secondly, non-smokers and ex-smokers were more likely to report their health status as better compared with last year in rural China. Thirdly, high tobacco consumption individuals had more possibility to rate their health status as worse in rural China. Fourthly, ex-smokers were more likely to report better health compared with last year in rural China and proves that the result of quitting may improve self-report health status.

In summary, tobacco consumption crowded out household expenditures on other goods in rural China, imposing an unwanted economic burden on tobacco consumption households. Additionally, tobacco consumption has a substantial impact on self-rated health, and it leads to enormous health burden on individual smokers.

5.1.3 Tobacco Use and Smoking Cessation Intervention

These findings from the Topic #1 and the Topic #2 imply that tobacco use (consumption) adds a great burden to the society of rural China, and an effective smoking cessation intervention should be introduced.

The key findings are summarized from Topic #3 as follows: The TM plus GBT was more cost-effective compared to the NRT at 3 months based on the continuous abstinence rate as effectiveness measurement among college-aged adult smokers in Inner Mongolia, China.

In summary, the Social Security Bureau of Inner Mongolia may consider involving the TM plus GBT intervention to the package of the BMIURR, reducing the burden of tobacco use.

5.2 Policy implications

Chinese policymakers might consider controlling tobacco use among rural households because the results of this study revealed that tobacco control could improve not only rural household welfare but also rural household members' health status. Moreover, it should compare the tobacco revenue against the harm of tobacco use on rural smokers and their households. Rural residents spent 17.3% of disposal income on cigarettes in 2015 compared to 21.1% in 2010 (Chinese Center for Disease Control and Prevention, 2016), and cigarettes may have become more affordable. Policy measures should concentrate on rural China. Details of policy implications are as follows:

5.2.1 Tobacco Taxes for Health Insurance

The current study displayed that smokers were more likely to use health care services and invade the right of non-smokers under health insurance systems. The government may consider implementing tobacco taxes, which not only reduces the smoking prevalence but also creates revenues and this policy may improve financial viability of a health insurance system.

5.2.2 Expand Smoking Cessation in General and Specialized Hospital

The present study found that former smokers preferred to visit the general and specialized hospital. This implies that the general and specialized hospital might consider offering smoking cessation therapies, which help the former smoker to avoid smoking cessation relapse.

5.2.3 Tobacco Control in Poverty Alleviation Policies

Chinese President Xi has committed to completely eliminate poverty by 2020. This study presents that rural households in China will benefit from the reduction of their tobacco consumption, because they would have much higher disposable household income that can be spent on food, dress, health care, and education. Therefore, Chinese government should integrate tobacco control into its poverty alleviation policies.

5.2.4 Cost-effectiveness of the Smoking Cessation Intervention

Among college-aged adult in Inner Mongolia, the TM plus GBT was less costly and more effective than the NRT based on the measurement of continuous abstinence rate. The Social Security Bureau of Inner Mongolia may consider starting with the TM plus GBT intervention to the package of the BMIURR. At first, the college-aged smokers or young smokers should participate the TM plus GBT intervention provided by the BMIURR. With the development of related studies, the smoking cessation intervention should be extended to other age group smokers.

5.2.5 Further Studies

5.2.5.1 Factors affecting tobacco consumption pattern of rural household

1 Endogeneity Problem

This study used a number of the regressors, such as tobacco use, self-rated health, and drinking, which might be the sources of endogeneity problems. While the lack of viable instruments in dataset of CFPS, the current study could not explore this

problem. Further studies might consider endogeneity problem under the condition of database.

2 Tobacco Price

In the absence of tobacco price, the current study may underestimate tobacco consumption expenditure among the higher income households in rural China. The impact of tobacco consumption expenditure on other household spending such as food, dress, daily expenditure, transportations, communication, medical, health care products, health care services, other goods and services may be underestimated.

5.2.5.2 Tobacco Tax

The impact of tobacco tax on smoking prevalence and government revenues has not been analyzed in this study. Further studies might consider dealing with this problem and the health care financing policy choices would be proposed for health care system.

5.2.5.3 Randomized Controlled Trial

There were several limitations of the randomized controlled trial in this study, such as target population, measurement of effectiveness, and follow up. Further studies might consider to (1) extend the target population from college-aged adults to adults in all age groups; (2) employ biochemical measurement; (3) collect the effectiveness data after 1-year follow-up and 3-year follow-up.

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APPENDIX A

Table A1 Impact of Smoking Status on Outpatient Utilization by the Fixed Effect Logistic Model

Outpatient utilization	OR	Std. Err.	z	P>|z|
Cons	-	-	-	-
Male	-	-	-	-
Age group, years				
16-24 (ref.)	1.00	1.00	1.00	1.000
25-34	1.28	0.28	1.12	0.263
35-44	1.46	0.40	1.40	0.161
45-64	1.78**	0.52	1.97	0.049
>=65	2.08**	0.66	2.30	0.021
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	1.80**	0.42	2.55	0.011
Middle school	12.36**	14.71	2.11	0.035
High school	10.56**	12.43	2.00	0.045
Above three-year college	5.21	6.50	1.32	0.186
Married	0.67**	0.11	-2.36	0.018
Medical insurance	1.09	0.08	1.09	0.276
Employment	1.22***	0.06	4.03	0.000
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.00
Low income	1.07	0.06	1.23	0.218
High income	1.02	0.06	0.39	0.697
Ethnic minorities	-	-	-	-

Family size	1.03***	0.01	2.86	0.004
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	3.07***	0.19	18.55	0.000
Bad	0.64***	0.03	-8.50	0.000
Drinking habits	0.89	0.08	-1.30	0.193
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	2.16***	0.52	3.21	0.001
Heavy smokers	1.90**	0.51	2.42	0.015
Recent quitters	2.06***	0.56	2.66	0.008
Moderate-term quitters	2.64***	0.82	3.12	0.002
Long-term quitters	3.80***	1.68	3.02	0.003

Note: Asterisks*** indicates statistical significance at the 1% level.

Source: Author

Table A2 Impact of Smoking Status on Outpatient Utilization by the Random Effect Logistic Model

Outpatient utilization	OR	Std. Err.	z	P>|z|
Cons	0.10***	0.01	-16.78	0.000
Male	0.69***	0.04	-6.09	0.000
Age group, years				
16-24 (ref.)	1.00	1.00	1.00	1.000
25-34	1.45***	0.18	3.01	0.003
35-44	1.84***	0.22	5.15	0.000
45-64	2.45***	0.28	7.80	0.000
>=65	3.16***	0.38	9.58	0.000

Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	1.00	0.05	0.08	0.938
Middle school	0.94	0.05	-1.21	0.228
High school	0.98	0.08	-0.22	0.829
Above three-year college	0.87	0.15	-0.76	0.446
Married	0.93	0.06	-1.23	0.219
Medical insurance	1.16**	0.07	2.42	0.016
Employment	1.19***	0.04	4.74	0.000
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	1.03	0.05	0.76	0.446
High income	0.97	0.04	-0.76	0.449
Ethnic minorities	0.68***	0.05	-5.63	0.000
Family size	1.03***	0.01	2.86	0.004
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	4.68***	0.22	33.27	0.000
Bad	0.42***	0.02	-20.42	0.000
Drinking habits	0.80***	0.04	-4.14	0.000
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	1.04	0.08	0.52	0.603
Heavy smokers	1.13*	0.08	1.77	0.076
Recent quitters	1.00	0.11	0.01	0.993
Moderate-term quitters	1.23	0.17	1.53	0.127

Long-term quitters	1.23*	0.14	1.87	0.061

Note: Asterisks*** indicates statistical significance at the 1% level, ** at the 5% level, * at the 10% level.

Source: Author

Table A3 Impact of Smoking Status on Inpatient Utilization by the Fixed Effect Logistic Model

Inpatient utilization	OR	Std. Err.	z	P>|z|
Cons	-	-	-	-
Male	-	-	-	-
Age group, years				
16-24 (ref.)	1.00	1.00	1.00	1.000
25-34	1.24	0.29	0.93	0.351
35-44	1.05	0.34	0.16	0.872
45-64	1.51	0.53	1.17	0.244
>=65	1.63	0.63	1.26	0.208
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	1.64	0.51	1.58	0.114
Middle school	0.53	0.70	-0.48	0.633
High school	0.52	0.70	-0.49	0.626
Above three-year				
college	0.62	0.90	-0.33	0.743
Married	1.65**	0.36	2.30	0.022
Medical insurance	1.26**	0.13	2.22	0.026
Employment	0.91	0.06	-1.55	0.121
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000

Low income	1.19**	0.09	2.25	0.025
High income	0.95	0.07	-0.71	0.475
Ethnic minorities	-	-	-	-
Family size	1.03***	0.01	2.86	0.004
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	2.00***	0.16	8.62	0.000
Bad	0.71***	0.05	-4.56	0.000
Drinking habits	0.71***	0.08	-2.87	0.004
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	1.54	0.48	1.40	0.160
Heavy smokers	1.23	0.42	0.60	0.550
Recent quitters	3.12***	1.08	3.29	0.001
Moderate-term quitters	2.73**	1.07	2.57	0.010
Long-term quitters	4.36***	2.33	2.75	0.006

Note: Asterisks*** indicates statistical significance at the 1% level, ** at the 5% level.

Source: Author

Table A4 Impact of Smoking Status on Inpatient Utilization by the Random Effect Logistic Model

Inpatient utilization	OR	Std. Err.	z	P>|z|
Cons	0.04***	0.01	-18.55	0.000
Male	1.03	0.08	0.43	0.670
Age group, years				
16-24 (ref.)	1.00	1.00	1.00	1.000
25-34	1.06	0.15	0.38	0.707

35-44	0.68***	0.10	-2.66	0.008
45-64	1.07	0.15	0.49	0.627
>=65	1.53***	0.22	2.99	0.003
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	0.91	0.06	-1.54	0.124
Middle school	0.95	0.07	-0.69	0.488
High school	0.98	0.11	-0.15	0.884
Above three-year college	1.10	0.24	0.44	0.663
Married	1.45***	0.12	4.49	0.000
Medical insurance	1.27***	0.11	2.88	0.004
Employment	1.19***	0.04	4.74	0.000
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	1.08	0.06	1.25	0.212
High income	1.01	0.06	0.24	0.807
Ethnic minorities	1.01	0.06	0.24	0.807
Family size	1.01	0.01	0.78	0.435
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	2.85***	0.17	17.19	0.000
Bad	0.57***	0.03	-9.24	0.000
Drinking habits	0.76***	0.06	-3.67	0.000
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	0.84*	0.08	-1.82	0.069

Heavy smokers	0.80**	0.07	-2.45	0.014
Recent quitters	1.78***	0.21	4.77	0.000
Moderate-term quitters	1.50**	0.24	2.49	0.013
Long-term quitters	1.31*	0.18	1.92	0.055

Note: Asterisks*** indicates statistical significance at the 1% level, ** at the 5% level, * at the 10% level

Source: Author

APPENDIX B

Table B1 Choice of Health Facility among Current Smokers and Former Smokers Based on the Clinic

Hospital	RR	Std. Err.	z	P>|z|
General hospital				
Cons	1.33	0.31	1.23	0.219
Male	0.98	0.10	-0.15	0.883
Age group, years				
16-24	0.90	0.17	-0.57	0.572
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	1.10	0.14	0.74	0.458
45-64	1.22*	0.14	1.73	0.084
>=65	1.62***	0.23	3.32	0.001
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	1.18*	0.11	1.88	0.060
Middle school	1.36***	0.13	3.24	0.001
High school	1.65***	0.23	3.69	0.000
Above three-year college	3.47***	0.72	6.03	0.000
Married	1.48***	0.17	3.52	0.000
Medical insurance	0.78*	0.10	-1.89	0.059
Employment	0.81***	0.07	-2.65	0.008
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	0.83**	0.07	-2.10	0.035

High income	1.16[*]	0.09	1.83	0.067
Ethnic minorities	2.13^{***}	0.27	6.04	0.000
Family size	0.87^{***}	0.02	-7.66	0.000
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	1.56^{***}	0.17	4.02	0.000
Bad	0.82^{**}	0.08	-2.03	0.042
Drinking habits	1.07	0.11	0.63	0.527
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	0.95	0.13	-0.40	0.687
Heavy smokers	0.79[*]	0.10	-1.88	0.061
Recent quitters	1.54^{**}	0.30	2.23	0.026
Moderate-term quitters	0.95	0.19	-0.25	0.804
Long-term quitters	1.42[*]	0.28	1.75	0.081
Specialized hospital				
Cons	0.20^{***}	0.08	-3.96	0.000
Male	1.03	0.19	0.16	0.876
Age group, years				
16-24	1.13	0.35	0.39	0.699
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	1.22	0.26	0.95	0.345
45-64	1.08	0.21	0.39	0.694
>=65	0.98	0.24	-0.07	0.941
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	1.05	0.16	0.34	0.735

Middle school	1.31*	0.21	1.70	0.090
High school	1.36	0.31	1.31	0.190
Above three-year college	1.68	0.61	1.43	0.152
Married	1.55**	0.31	2.20	0.028
Medical insurance	1.02	0.24	0.08	0.936
Employment	0.57***	0.08	-4.26	0.000
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	0.79	0.12	-1.54	0.125
High income	0.87	0.12	-1.04	0.300
Ethnic minorities	1.84***	0.37	3.01	0.003
Family size	0.95*	0.03	-1.71	0.088
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	1.62**	0.31	2.51	0.012
Bad	0.94	0.16	-0.38	0.703
Drinking habits	0.81	0.15	-1.13	0.260
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	1.28	0.28	1.11	0.266
Heavy smokers	0.97	0.21	-0.13	0.898
Recent quitters	1.90**	0.58	2.12	0.034
Moderate-term quitters	0.94	0.33	-0.18	0.854
Long-term quitters	1.79*	0.57	1.83	0.067
Township hospital				
Cons	0.61	0.13	-2.25	0.025

Male	1.06	0.11	0.60	0.546
Age group, years				
16-24	0.81	0.15	-1.11	0.265
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	1.60***	0.19	4.00	0.000
45-64	1.70***	0.18	4.92	0.000
>=65	2.17***	0.29	5.76	0.000
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	1.01	0.08	0.18	0.857
Middle school	1.00	0.09	-0.05	0.963
High school	1.05	0.14	0.39	0.697
Above three-year college	1.12	0.25	0.51	0.610
Married	1.28**	0.13	2.41	0.016
Medical insurance	1.08	0.14	0.56	0.576
Employment	1.13	0.09	1.51	0.131
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	1.02	0.08	0.24	0.813
High income	0.95	0.07	-0.71	0.476
Ethnic minorities	2.58***	0.29	8.40	0.000
Family size	0.98	0.02	-1.19	0.233
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	0.93	0.10	-0.65	0.517
Bad	1.00	0.09	-0.03	0.976

Drinking habits	1.20**	0.11	1.99	0.047
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	1.08	0.13	0.61	0.542
Heavy smokers	0.87	0.10	-1.21	0.227
Recent quitters	1.20	0.22	0.95	0.341
Moderate-term quitters	1.01	0.18	0.06	0.955
Long-term quitters	1.14	0.22	0.70	0.486
Village health center				
Cons	0.64**	0.14	-2.09	0.037
Male	0.97	0.09	-0.36	0.716
Age group, years				
16-24	0.56***	0.11	-3.09	0.002
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	1.68***	0.19	4.64	0.000
45-64	1.94***	0.20	6.43	0.000
>=65	2.92***	0.37	8.38	0.000
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	1.29***	0.10	3.35	0.001
Middle school	1.28***	0.11	3.03	0.002
High school	1.21	0.15	1.52	0.129
Above three-year college	0.98	0.23	-0.08	0.936
Married	1.15	0.11	1.39	0.164
Medical insurance	1.24*	0.16	1.67	0.096
Employment	1.25***	0.09	2.97	0.003

Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	0.95	0.07	-0.60	0.548
High income	0.88*	0.06	-1.76	0.079
Ethnic minorities	1.26*	0.15	1.96	0.050
Family size	0.97*	0.02	-1.71	0.088
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	0.88	0.09	-1.29	0.198
Bad	1.16*	0.10	1.79	0.074
Drinking habits	1.17*	0.10	1.74	0.082
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	0.92	0.11	-0.75	0.451
Heavy smokers	0.79**	0.09	-2.18	0.029
Recent quitters	1.13	0.20	0.69	0.492
Moderate-term quitters	0.71*	0.13	-1.89	0.059
Long-term quitters	0.95	0.18	-0.25	0.801
Clinic		Base outcome		

Note: Asterisks*** indicates statistical significance at the 1% level, ** at the 5% level, * at the 10% level.

Source: Author

Table B2 Choice of Health Facility among Current Smokers and Former Smokers Based on the Village Health Center

Hospital	RR	Std. Err.	z	P>|z|
General hospital				
Cons	2.08***	0.45	3.43	0.001

Male	1.02	0.09	0.20	0.839
Age group, years				
16-24	1.61**	0.32	2.39	0.017
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	0.65***	0.08	-3.55	0.000
45-64	0.63***	0.07	-4.23	0.000
>=65	0.55***	0.07	-4.59	0.000
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	0.91	0.07	-1.15	0.249
Middle school	1.06	0.09	0.70	0.481
High school	1.37***	0.16	2.61	0.009
Above three-year college	3.53***	0.73	6.07	0.000
Married	1.29	0.13	2.55	0.011
Medical insurance	0.63***	0.08	-3.80	0.000
Employment	0.64***	0.05	-6.08	0.000
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	0.87*	0.07	-1.81	0.070
High income	1.31***	0.09	3.82	0.000
Ethnic minorities	1.69***	0.17	5.09	0.000
Family size	0.89***	0.02	-6.95	0.000
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	1.79***	0.17	6.00	0.000
Bad	0.70***	0.06	-4.11	0.000

Drinking habits	0.91	0.08	-1.01	0.313
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	1.04	0.12	0.29	0.771
Heavy smokers	1.00	0.11	0.01	0.991
Recent quitters	1.36*	0.22	1.95	0.051
Moderate-term quitters	1.34	0.24	1.65	0.100
Long-term quitters	1.49**	0.24	2.43	0.015
Specialized hospital				
Cons	0.31***	0.12	-2.94	0.003
Male	1.06	0.19	0.36	0.720
Age group, years				
16-24	2.02**	0.64	2.22	0.027
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	0.73	0.15	-1.54	0.124
45-64	0.56***	0.11	-3.04	0.002
>=65	0.34***	0.08	-4.54	0.000
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	0.81	0.12	-1.39	0.166
Middle school	1.02	0.15	0.13	0.899
High school	1.12	0.25	0.51	0.608
Above three-year college	1.72	0.63	1.47	0.140
Married	1.35	0.26	1.56	0.119
Medical insurance	0.82	0.19	-0.84	0.401
Employment	0.45***	0.06	-6.19	0.000

Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	0.83	0.12	-1.28	0.200
High income	0.98	0.13	-0.15	0.883
Ethnic minorities	1.46[**]	0.28	1.98	0.047
Family size	0.97	0.03	-0.89	0.375
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	1.85[***]	0.34	3.34	0.001
Bad	0.80	0.13	-1.31	0.192
Drinking habits	0.69[**]	0.12	-2.04	0.042
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	1.40	0.30	1.57	0.116
Heavy smokers	1.23	0.26	0.99	0.320
Recent quitters	1.68[*]	0.47	1.84	0.066
Moderate-term quitters	1.32	0.45	0.81	0.419
Long-term quitters	1.88[**]	0.56	2.12	0.034
Township hospital				
Cons	0.95	0.19	-0.27	0.791
Male	1.10	0.09	1.13	0.260
Age group, years				
16-24	1.46[*]	0.29	1.91	0.056
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	0.95	0.10	-0.46	0.643
45-64	0.88	0.09	-1.30	0.193
>=65	0.74[**]	0.09	-2.54	0.011

Education

Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	0.78***	0.05	-3.61	0.000
Middle school	0.78***	0.06	-3.48	0.001
High school	0.87	0.10	-1.24	0.214
Above three-year college	1.14	0.26	0.59	0.555
Married	1.12	0.10	1.24	0.214
Medical insurance	0.87	0.10	-1.18	0.240
Employment	0.90	0.06	-1.52	0.128
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	1.07	0.07	0.97	0.330
High income	1.07	0.07	1.12	0.264
Ethnic minorities	2.05***	0.18	8.22	0.000
Family size	1.01	0.01	0.52	0.603
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	1.07	0.10	0.70	0.482
Bad	0.86**	0.06	-2.08	0.037
Drinking habits	1.03	0.08	0.37	0.708
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	1.18	0.12	1.58	0.114
Heavy smokers	1.11	0.11	1.05	0.295
Recent quitters	1.06	0.16	0.37	0.712
Moderate-term quitters	1.42**	0.22	2.23	0.026

Long-term quitters	1.20	0.19	1.18	0.237
Clinic				
Cons	1.56**	0.33	2.09	0.037
Male	1.04	0.10	0.36	0.716
Age group, years				
16-24	1.79***	0.34	3.09	0.002
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	0.59***	0.07	-4.64	0.000
45-64	0.52***	0.05	-6.43	0.000
>=65	0.34***	0.04	-8.38	0.000
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	0.77***	0.06	-3.35	0.001
Middle school	0.78***	0.06	-3.03	0.002
High school	0.83	0.10	-1.52	0.129
Above three-year college	1.02	0.23	0.08	0.936
Married	0.87	0.09	-1.39	0.164
Medical insurance	0.81	0.10	-1.67	0.096
Employment	0.80***	0.06	-2.97	0.003
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	1.05	0.08	0.60	0.548
High income	0.88*	0.06	-1.76	0.079
Ethnic minorities	0.79*	0.09	-1.96	0.050
Family size	1.03*	0.02	1.71	0.088
Health status				

Fair (ref.)	1.00	1.00	1.00	1.000
Good	1.14	0.12	1.29	0.198
Bad	0.86*	0.07	-1.79	0.074
Drinking habits	0.86*	0.08	-1.74	0.082
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	1.09	0.13	0.75	0.451
Heavy smokers	1.27**	0.14	2.18	0.029
Recent quitters	0.88	0.16	-0.69	0.492
Moderate-term quitters	1.40*	0.25	1.89	0.059
Long-term quitters	1.05	0.20	0.25	0.801
Village health center		Base outcome		

Note: Asterisks*** indicates statistical significance at the 1% level, ** at the 5% level, * at the 10% level.

Source: Author

Table B3 Choice of Health Facility among Current Smokers and Former Smokers Based on the Township Hospital

Hospital	RR	Std. Err.	z	P>|z|
General hospital				
Cons	2.20***	0.49	3.55	0.000
Male	0.93	0.09	-0.78	0.437
Age group, years				
16-24	1.11	0.22	0.52	0.606
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	0.69***	0.09	-3.03	0.002
45-64	0.72***	0.08	-2.93	0.003
>=65	0.74**	0.10	-2.19	0.029
Education				

Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	1.17*	0.10	1.89	0.059
Middle school	1.37***	0.12	3.59	0.000
High school	1.57***	0.20	3.61	0.000
Above three-year college	3.09***	0.63	5.55	0.000
Married	1.15	0.12	1.37	0.172
Medical insurance	0.72***	0.09	-2.60	0.009
Employment	0.71***	0.05	-4.43	0.000
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	0.81**	0.07	-2.56	0.011
High income	1.22***	0.09	2.68	0.007
Ethnic minorities	0.83*	0.08	-1.96	0.050
Family size	0.88***	0.02	-7.14	0.000
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	1.68***	0.17	5.16	0.000
Bad	0.82**	0.07	-2.21	0.027
Drinking habits	0.89	0.08	-1.29	0.198
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	0.88	0.11	-1.05	0.294
Heavy smokers	0.91	0.10	-0.86	0.390
Recent quitters	1.29	0.22	1.53	0.127

Moderate-term				
quitters	0.94	0.17	-0.33	0.739
Long-term quitters	1.24	0.21	1.27	0.205

Specialized hospital

Cons	0.33***	0.13	-2.79	0.005
Male	0.97	0.17	-0.18	0.859

Age group, years

16-24	1.39	0.44	1.04	0.299
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	0.76	0.16	-1.28	0.200
45-64	0.63**	0.12	-2.34	0.019
>=65	0.45***	0.11	-3.26	0.001

Education

Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	1.04	0.16	0.25	0.802
Middle school	1.31*	0.20	1.77	0.076
High school	1.29	0.29	1.12	0.262
Above three-year				
college	1.50	0.54	1.12	0.264

Married	1.21	0.24	0.97	0.332
Medical insurance	0.95	0.22	-0.23	0.816
Employment	0.51***	0.07	-5.29	0.000

Household income

Moderate income				
(ref.)	1.00	1.00	1.00	1.000
Low income	0.78*	0.11	-1.71	0.087
High income	0.91	0.12	-0.67	0.503

Ethnic minorities	0.71*	0.13	-1.82	0.069
Family size	0.97	0.03	-1.12	0.265
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	1.74***	0.32	2.97	0.003
Bad	0.94	0.16	-0.38	0.707
Drinking habits	0.67**	0.12	-2.18	0.029
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	1.19	0.26	0.80	0.423
Heavy smokers	1.12	0.24	0.52	0.606
Recent quitters	1.59	0.46	1.62	0.105
Moderate-term quitters	0.93	0.32	-0.22	0.827
Long-term quitters	1.57	0.47	1.49	0.136
Village health center				
Cons	1.05	0.21	0.27	0.791
Male	0.91	0.08	-1.13	0.260
Age group, years				
16-24	0.69*	0.14	-1.91	0.056
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	1.05	0.11	0.46	0.643
45-64	1.14	0.11	1.30	0.193
>=65	1.35**	0.16	2.54	0.011
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	1.28***	0.09	3.61	0.000

Middle school	1.29***	0.09	3.48	0.001
High school	1.15	0.13	1.24	0.214
Above three-year college	0.87	0.20	-0.59	0.555
Married	0.89	0.08	-1.24	0.214
Medical insurance	1.15	0.14	1.18	0.240
Employment	1.11	0.08	1.52	0.128
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	0.94	0.06	-0.97	0.330
High income	0.93	0.06	-1.12	0.264
Ethnic minorities	0.49***	0.04	-8.22	0.000
Family size	0.99	0.01	-0.52	0.603
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	0.94	0.08	-0.70	0.482
Bad	1.17**	0.09	2.08	0.037
Drinking habits	0.97	0.07	-0.37	0.708
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	0.85	0.09	-1.58	0.114
Heavy smokers	0.90	0.09	-1.05	0.295
Recent quitters	0.95	0.14	-0.37	0.712
Moderate-term quitters	0.70**	0.11	-2.23	0.026
Long-term quitters	0.83	0.13	-1.18	0.237

Clinic				
Cons	1.65**	0.37	2.25	0.025
Male	0.94	0.09	-0.60	0.546
Age group, years				
16-24	1.23	0.23	1.11	0.265
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	0.62***	0.07	-4.00	0.000
45-64	0.59***	0.06	-4.92	0.000
>=65	0.46***	0.06	-5.76	0.000
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	0.99	0.08	-0.18	0.857
Middle school	1.00	0.09	0.05	0.963
High school	0.95	0.12	-0.39	0.697
Above three-year college	0.89	0.20	-0.51	0.610
Married	0.78	0.08	-2.41	0.016
Medical insurance	0.93	0.12	-0.56	0.576
Employment	0.89	0.07	-1.51	0.131
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	0.98	0.08	-0.24	0.813
High income	1.05	0.08	0.71	0.476
Ethnic minorities	0.39***	0.04	-8.40	0.000
Family size	1.02	0.02	1.19	0.233
Health status				

Fair (ref.)	1.00	1.00	1.00	1.000
Good	1.07	0.11	0.65	0.517
Bad	1.00	0.09	0.03	0.976
Drinking habits	0.83**	0.08	-1.99	0.047
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	0.93	0.11	-0.61	0.542
Heavy smokers	1.15	0.13	1.21	0.227
Recent quitters	0.84	0.16	-0.95	0.341
Moderate-term quitters	0.99	0.18	-0.06	0.955
Long-term quitters	0.87	0.17	-0.70	0.486
Township hospital		Base outcome		

Note: Asterisks*** indicates statistical significance at the 1% level, ** at the 5% level, * at the 10% level.

Source: Author

Table B4 Choice of Health Facility among Current Smokers and Former Smokers Based on the Specialized Hospital

Hospital	RR	Std. Err.	z	P>|z|
General hospital				
Cons	6.76***	2.76	4.68	0.000
Male	0.96	0.17	-0.24	0.807
Age group, years				
16-24	0.80	0.25	-0.72	0.473
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	0.90	0.19	-0.49	0.624
45-64	1.13	0.22	0.62	0.533
>=65	1.64**	0.41	2.01	0.045

Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	1.12	0.17	0.75	0.452
Middle school	1.04	0.16	0.25	0.804
High school	1.22	0.28	0.87	0.384
Above three-year college	2.06**	0.72	2.06	0.039
Married	0.95	0.19	-0.23	0.817
Medical insurance	0.76	0.18	-1.16	0.247
Employment	1.41***	0.18	2.66	0.008
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	1.05	0.16	0.31	0.759
High income	1.34**	0.19	2.10	0.036
Ethnic minorities	1.16	0.22	0.77	0.441
Family size	0.91	0.03	-2.84	0.004
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	0.97	0.18	-0.19	0.852
Bad	0.88	0.15	-0.76	0.445
Drinking habits	1.32	0.25	1.48	0.138
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	0.74	0.16	-1.36	0.175
Heavy smokers	0.81	0.18	-0.95	0.341
Recent quitters	0.81	0.23	-0.72	0.469
Moderate-term quitters	1.02	0.35	0.05	0.964

Long-term quitters	0.79	0.24	-0.77	0.439
Township hospital				
Cons	3.08***	1.24	2.79	0.005
Male	1.03	0.18	0.18	0.859
Age group, years				
16-24	0.72	0.23	-1.04	0.299
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	1.31	0.28	1.28	0.200
45-64	1.58**	0.31	2.34	0.019
>=65	2.21***	0.54	3.26	0.001
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	0.96	0.14	-0.25	0.802
Middle school	0.76*	0.12	-1.77	0.076
High school	0.78	0.18	-1.12	0.262
Above three-year college	0.67	0.24	-1.12	0.264
Married	0.83	0.16	-0.97	0.332
Medical insurance	0.83	0.16	-0.97	0.332
Employment	1.98***	0.26	5.29	0.000
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	1.29*	0.19	1.71	0.087
High income	1.10	0.15	0.67	0.503
Ethnic minorities	1.40*	0.26	1.82	0.069
Family size	1.03	0.03	1.12	0.265
Health status				

Fair (ref.)	1.00	1.00	1.00	1.000
Good	0.58[***]	0.11	-2.97	0.003
Bad	1.07	0.18	0.38	0.707
Drinking habits	1.48[**]	0.27	2.18	0.029
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	0.84	0.18	-0.80	0.423
Heavy smokers	0.90	0.19	-0.52	0.606
Recent quitters	0.63	0.18	-1.62	0.105
Moderate-term quitters	1.08	0.37	0.22	0.827
Long-term quitters	0.64	0.19	-1.49	0.136
Village health center				
Cons	3.24[***]	1.29	2.94	0.003
Male	0.94	0.16	-0.36	0.720
Age group, years				
16-24	0.49[**]	0.16	-2.22	0.027
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	1.38	0.29	1.54	0.124
45-64	1.79[***]	0.34	3.04	0.002
>=65	2.97[***]	0.71	4.54	0.000
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	1.23	0.18	1.39	0.166
Middle school	0.98	0.15	-0.13	0.899
High school	0.89	0.20	-0.51	0.608
Above three-year college	0.58	0.21	-1.47	0.140

Married	0.74	0.14	-1.56	0.119
Medical insurance	1.22	0.28	0.84	0.401
Employment	2.20***	0.28	6.19	0.000
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	1.21	0.18	1.28	0.200
High income	1.02	0.14	0.15	0.883
Ethnic minorities	0.69**	0.13	-1.98	0.047
Family size	1.03	0.03	0.89	0.375
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	0.54***	0.10	-3.34	0.001
Bad	1.24	0.21	1.31	0.192
Drinking habits	1.44**	0.26	2.04	0.042
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	0.72	0.15	-1.57	0.116
Heavy smokers	0.81	0.17	-0.99	0.320
Recent quitters	0.60*	0.17	-1.84	0.066
Moderate-term quitters	0.76	0.26	-0.81	0.419
Long-term quitters	0.53**	0.16	-2.12	0.034
Clinic				
Cons	5.06***	2.08	3.96	0.000
Male	0.97	0.18	-0.16	0.876
Age group, years				
16-24	0.89	0.28	-0.39	0.699
25-34(ref.)	1.00	1.00	1.00	1.000

35-44	0.82	0.17	-0.95	0.345
45-64	0.93	0.18	-0.39	0.694
>=65	1.02	0.25	0.07	0.941
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	0.95	0.15	-0.34	0.735
Middle school	0.76*	0.12	-1.70	0.090
High school	0.74	0.17	-1.31	0.190
Above three-year college	0.59	0.22	-1.43	0.152
Married	0.65**	0.13	-2.20	0.028
Medical insurance	0.98	0.23	-0.08	0.936
Employment	1.76***	0.23	4.26	0.000
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	1.26	0.19	1.54	0.125
High income	1.16	0.16	1.04	0.300
Ethnic minorities	0.54***	0.11	-3.01	0.003
Family size	1.06*	0.03	1.71	0.088
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	0.62**	0.12	-2.51	0.012
Bad	1.07	0.19	0.38	0.703
Drinking habits	1.23	0.23	1.13	0.260
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	0.78	0.17	-1.11	0.266

Heavy smokers	1.03	0.23	0.13	0.898
Recent quitters	0.53**	0.16	-2.12	0.034
Moderate-term quitters	1.07	0.37	0.18	0.854
Long-term quitters	0.56*	0.18	-1.83	0.067
Specialized hospital	Base outcome			

Note: Asterisks*** indicates statistical significance at the 1% level, ** at the 5% level, * at the 10% level.

Source: Author

Table B5 Choice of Health Facility among Current Smokers and Former Smokers Based on the General Hospital

Hospital	RR	Std. Err.	z	P>|z|
Specialized hospital				
Cons	0.15***	0.06	-4.68	0.000
Male	1.05	0.19	0.24	0.807
Age group, years				
16-24	1.25	0.39	0.72	0.473
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	1.11	0.24	0.49	0.624
45-64	0.88	0.18	-0.62	0.533
>=65	0.61**	0.15	-2.01	0.045
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	0.89	0.14	-0.75	0.452
Middle school	0.96	0.15	-0.25	0.804
High school	0.82	0.19	-0.87	0.384
Above three-year college	0.49**	0.17	-2.06	0.039
Married	1.05	0.21	0.23	0.817

Medical insurance	1.31	0.31	1.16	0.247
Employment	0.71***	0.09	-2.66	0.008
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	0.95	0.15	-0.31	0.759
High income	0.75**	0.10	-2.10	0.036
Ethnic minorities	0.86	0.17	-0.77	0.441
Family size	1.10***	0.04	2.84	0.004
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	1.04	0.20	0.19	0.852
Bad	1.14	0.20	0.76	0.445
Drinking habits	0.76	0.14	-1.48	0.138
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	1.35	0.30	1.36	0.175
Heavy smokers	1.23	0.27	0.95	0.341
Recent quitters	1.23	0.36	0.72	0.469
Moderate-term quitters	0.98	0.34	-0.05	0.964
Long-term quitters	1.26	0.38	0.77	0.439
Township hospital				
Cons	0.46***	0.10	-3.55	0.000
Male	1.08	0.10	0.78	0.437
Age group, years				
16-24	0.90	0.18	-0.52	0.606
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	1.46***	0.18	3.03	0.002

45-64	1.39***	0.16	2.93	0.003
>=65	1.34**	0.18	2.19	0.029
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	0.86*	0.07	-1.89	0.059
Middle school	0.73***	0.06	-3.59	0.000
High school	0.64***	0.08	-3.61	0.000
Above three-year college	0.32***	0.07	-5.55	0.000
Married	0.87	0.09	-1.37	0.172
Medical insurance	1.39***	0.17	2.60	0.009
Employment	1.40***	0.11	4.43	0.000
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	1.23**	0.10	2.56	0.011
High income	0.82***	0.06	-2.68	0.007
Ethnic minorities	1.21*	0.12	1.96	0.050
Family size	1.13***	0.02	7.14	0.000
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	0.60***	0.06	-5.16	0.000
Bad	1.22**	0.11	2.21	0.027
Drinking habits	1.13	0.10	1.29	0.198
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	1.14	0.14	1.05	0.294
Heavy smokers	1.10	0.13	0.86	0.390

Recent quitters	0.78	0.13	-1.53	0.127
Moderate-term quitters	1.06	0.19	0.33	0.739
Long-term quitters	0.81	0.14	-1.27	0.205

Village health center

Cons	0.48	0.10	-3.43	0.001
Male	0.98	0.09	-0.20	0.839
Age group, years				
16-24	0.62	0.12	-2.39	0.017
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	1.53***	0.18	3.55	0.000
45-64	1.58***	0.17	4.23	0.000
>=65	1.81***	0.23	4.59	0.000
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	1.09	0.08	1.15	0.249
Middle school	0.94	0.08	-0.70	0.481
High school	0.73***	0.09	-2.61	0.009
Above three-year college	0.28***	0.06	-6.07	0.000
Married	0.77**	0.08	-2.55	0.011
Medical insurance	1.60***	0.20	3.80	0.000
Employment	1.55***	0.11	6.08	0.000
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	1.15*	0.09	1.81	0.070
High income	0.76***	0.05	-3.82	0.000
Ethnic minorities	0.59***	0.06	-5.09	0.000

Family size	1.13***	0.02	6.95	0.000
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	0.56***	0.05	-6.00	0.000
Bad	1.42***	0.12	4.11	0.000
Drinking habits	1.09	0.10	1.01	0.313
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	0.97	0.11	-0.29	0.771
Heavy smokers	1.00	0.11	-0.01	0.991
Recent quitters	0.73*	0.12	-1.95	0.051
Moderate-term quitters	0.75	0.13	-1.65	0.100
Long-term quitters	0.67**	0.11	-2.43	0.015
Clinic				
Cons	0.75	0.18	-1.23	0.219
Male	1.02	0.11	0.15	0.883
Age group, years				
16-24	1.11	0.21	0.57	0.572
25-34(ref.)	1.00	1.00	1.00	1.000
35-44	0.91	0.12	-0.74	0.458
45-64	0.82*	0.10	-1.73	0.084
>=65	0.62***	0.09	-3.32	0.001
Education				
Illiteracy (ref.)	1.00	1.00	1.00	1.000
Elementary school	0.84*	0.08	-1.88	0.060
Middle school	0.73***	0.07	-3.24	0.001
High school	0.60***	0.08	-3.69	0.000

Above three-year college	0.29***	0.06	-6.03	0.000
Married	0.68***	0.08	-3.52	0.000
Medical insurance	1.29*	0.17	1.89	0.059
Employment	1.24***	0.10	2.65	0.008
Household income				
Moderate income (ref.)	1.00	1.00	1.00	1.000
Low income	1.21**	0.11	2.10	0.035
High income	0.86*	0.07	-1.83	0.067
Ethnic minorities	0.47***	0.06	-6.04	0.000
Family size	1.16***	0.02	7.66	0.000
Health status				
Fair (ref.)	1.00	1.00	1.00	1.000
Good	0.64***	0.07	-4.02	0.000
Bad	1.22**	0.12	2.03	0.042
Drinking habits	0.94	0.10	-0.63	0.527
Smoking status				
Non-smokers (ref.)	1.00	1.00	1.00	1.000
Light smokers	1.06	0.14	0.40	0.687
Heavy smokers	1.27*	0.16	1.88	0.061
Recent quitters	0.65**	0.13	-2.23	0.026
Moderate-term quitters	1.05	0.21	0.25	0.804
Long-term quitters	0.70*	0.14	-1.75	0.081
General hospital	Base outcome			

Note: Asterisks*** indicates statistical significance at the 1% level, ** at the 5% level, * at the 10% level.

Source: Author

APPENDIX C

Table C1 Tobacco Consumption Impact on Rural Household Expenditure in Rural China (Two Waves 2010, 2012)

	Coef.	Std. Err.	Z	P>|z|
Food				
Gender	-0.82	0.68	-1.20	0.231
Age	0.10***	0.03	4.08	0.000
Ln(Family size)	-3.70***	0.63	-5.89	0.000
Employment	-0.85	0.52	-1.64	0.102
Elementary school	-0.64	0.68	-0.94	0.347
Middle school	-0.82	0.70	-1.17	0.242
High/ vocational school	-2.91**	1.00	-2.90	0.004
College or above	-3.45	2.45	-1.41	0.159
Unmarried	-12.00**	4.90	-2.45	0.014
Married	-16.81***	4.70	-3.58	0.000
Divorced	-10.46**	5.24	-2.00	0.046
Widow	-17.24***	4.79	-3.60	0.000
Insurance	-0.71	0.84	-0.84	0.401
Ethnicity	2.28**	0.90	2.52	0.012
Self-rated health				
Worse	-1.85***	0.54	-3.39	0.001
Self-rated health				
Better	0.66	0.79	0.84	0.403
Ln(Total household expenditure)	11.67***	1.07	10.89	0.000
Ln(Total household expenditure)*2	-0.68***	0.06	-11.04	0.000

Drinking	2.15***	0.55	3.93	0.000
LTCH	-1.95***	0.71	-2.72	0.006
MTCH	-0.70	0.63	-1.10	0.272
HTCH	0.42	0.83	0.51	0.613

Dress				
Gender	0.01	0.22	0.03	0.979
Age	-0.08***	0.01	-9.48	0.000
Ln(Family size)	2.32***	0.20	11.35	0.000
Employment	0.12	0.17	0.68	0.498
Elementary school	0.21	0.22	0.97	0.333
Middle school	0.29	0.23	1.26	0.209
High/ vocational school	1.05***	0.33	3.22	0.001
College or above	1.06	0.80	1.33	0.182
Unmarried	7.54***	1.60	4.72	0.000
Married	8.10***	1.53	5.30	0.000
Divorced	7.37***	1.71	4.31	0.000
Widow	8.27***	1.56	5.29	0.000
Insurance	1.17***	0.27	4.27	0.000
Ethnicity	1.85***	0.29	6.27	0.000
Self-rated health				
Worse	-0.74***	0.18	-4.18	0.000
Self-rated health				
Better	-1.01***	0.26	-3.90	0.000
Ln(Total household expenditure)	1.64***	0.35	4.69	0.000
Ln(Total household				
expenditure)*2	-0.20***	0.02	-9.76	0.000
Drinking	0.25	0.18	1.42	0.154

LTCH	-0.33	0.23	-1.42	0.156
MTCH	0.42**	0.21	2.05	0.040
HTCH	1.13***	0.27	4.18	0.000

House				
Gender	0.37	0.32	1.14	0.256
Age	0.05***	0.01	3.93	0.000
Ln(Family size)	-1.47***	0.30	-4.92	0.000
Employment	0.36	0.26	1.38	0.167
Elementary school	0.43	0.32	1.33	0.183
Middle school	0.68**	0.33	2.07	0.038
High/ vocational school	0.81*	0.47	1.72	0.085
College or above	1.39	1.15	1.21	0.227
Unmarried	1.96	2.35	0.83	0.406
Married	3.65	2.25	1.62	0.105
Divorced	1.95	2.51	0.78	0.437
Widow	4.18*	2.30	1.82	0.069
Insurance	1.41***	0.42	3.38	0.001
Ethnicity	-2.08***	0.42	-4.91	0.000
Self-rated health				
Worse	0.24	0.27	0.89	0.371
Self-rated health				
Better	-0.49	0.39	-1.24	0.214
Ln(Total household expenditure)	1.89***	0.51	3.67	0.000
Ln(Total household expenditure)*2	-0.18***	0.03	-6.21	0.000
Drinking	0.26	0.27	0.96	0.336
LTCH	0.51	0.35	1.48	0.138

MTCH	0.05	0.30	0.16	0.874
HTCH	0.76[*]	0.40	1.91	0.057

Daily

Gender	0.97[**]	0.45	2.17	0.030
Age	-0.01	0.02	-0.77	0.439
Ln(Family size)	0.52	0.42	1.25	0.210
Employment	1.10[***]	0.36	3.07	0.002
Elementary school	0.19	0.44	0.44	0.662
Middle school	0.77[*]	0.46	1.69	0.090
High/ vocational school	1.27[*]	0.66	1.94	0.052
College or above	0.40	1.60	0.25	0.800
Unmarried	19.23[***]	3.28	5.87	0.000
Married	16.12[***]	3.14	5.14	0.000
Divorced	15.37[***]	3.49	4.40	0.000
Widow	16.23[***]	3.20	5.07	0.000
Insurance	-0.90	0.58	-1.54	0.123
Ethnicity	0.35	0.59	0.60	0.547
Self-rated health				
Worse	-0.64[*]	0.38	-1.70	0.088
Self-rated health				
Better	-0.27	0.55	-0.49	0.626
Ln(Total household expenditure)	-2.48[***]	0.72	-3.46	0.001
Ln(Total household expenditure)*2	0.20[***]	0.04	4.79	0.000
Drinking	0.95[**]	0.37	2.55	0.011
LTCH	0.20	0.48	0.42	0.673
MTCH	0.41	0.42	0.96	0.337

HTCH	0.13	0.56	0.23	0.816

Health				
Gender	-0.50	0.68	-0.73	0.463
Age	0.23***	0.02	9.36	0.000
Ln(Family size)	-3.58***	0.62	-5.82	0.000
Employment	-2.32***	0.50	-4.67	0.000
Elementary school	-1.97***	0.67	-2.94	0.003
Middle school	-4.17***	0.69	-6.01	0.000
High/ vocational school	-4.18***	0.99	-4.21	0.000
College or above	-2.74	2.42	-1.13	0.259
Unmarried	-1.93	4.77	-0.40	0.686
Married	1.00	4.58	0.22	0.827
Divorced	-3.71	5.12	-0.72	0.469
Widow	-0.66	4.67	-0.14	0.887
Insurance	-0.53	0.80	-0.66	0.508
Ethnicity	-2.01**	0.90	-2.24	0.025
Self-rated health				
Worse	3.21***	0.52	6.18	0.000
Self-rated health				
Better	1.63**	0.75	2.17	0.030
Ln(Total household expenditure)	1.57	1.04	1.50	0.133
Ln(Total household expenditure)*2	-0.01	0.06	-0.13	0.896
Drinking	-3.43***	0.53	-6.49	0.000
LTCH	0.95	0.69	1.38	0.169
MTCH	-1.44**	0.62	-2.33	0.020
HTCH	-3.47***	0.81	-4.28	0.000

Trco				
Gender	0.45	0.37	1.21	0.226
Age	-0.14***	0.01	-10.39	0.000
Ln(Family size)	1.81***	0.34	5.33	0.000
Employment	0.78***	0.28	2.80	0.005
Elementary school	0.63*	0.37	1.72	0.086
Middle school	1.17***	0.38	3.09	0.002
High/ vocational school	1.59***	0.54	2.94	0.003
College or above	3.96***	1.32	2.99	0.003
Unmarried	-2.05	2.64	-0.77	0.439
Married	-2.15	2.53	-0.85	0.395
Divorced	0.13	2.83	0.04	0.965
Widow	-1.79	2.58	-0.69	0.488
Insurance	-0.18	0.45	-0.39	0.697
Ethnicity	1.92***	0.49	3.92	0.000
Self-rated health				
Worse	0.33	0.29	1.14	0.255
Self-rated health				
Better	0.32	0.42	0.75	0.454
Ln(Total household expenditure)	5.88***	0.58	10.19	0.000
Ln(Total household				
expenditure)*2	-0.43***	0.03	-12.87	0.000
Drinking	0.72	0.30	2.42	0.015
LTCH	0.22	0.38	0.57	0.569
MTCH	1.22***	0.34	3.56	0.000
HTCH	2.92***	0.45	6.50	0.000
Edu				

Gender	-0.17	0.65	-0.26	0.796
Age	-0.13***	0.02	-5.51	0.000
Ln(Family size)	5.40***	0.57	9.54	0.000
Employment	0.35	0.42	0.83	0.404
Elementary school	1.04*	0.63	1.65	0.098
Middle school	2.15***	0.66	3.26	0.001
High/ vocational school	3.28***	0.94	3.48	0.000
College or above	-1.63	2.31	-0.71	0.480
Unmarried	-10.07**	4.29	-2.35	0.019
Married	-7.63*	4.13	-1.85	0.065
Divorced	-8.76*	4.65	-1.89	0.059
Widow	-5.64	4.22	-1.34	0.181
Insurance	-1.12*	0.67	-1.67	0.095
Ethnicity	-2.94***	0.86	-3.42	0.001
Self-rated health				
Worse	-0.74*	0.44	-1.69	0.090
Self-rated health				
Better	-0.77	0.63	-1.22	0.221
Ln(Total household expenditure)	1.69*	0.94	1.81	0.070
Ln(Total household expenditure)*2	0.03	0.05	0.50	0.616
Drinking	-0.79*	0.46	-1.71	0.087
LTCH	0.26	0.61	0.42	0.674
MTCH	0.15	0.56	0.26	0.794
HTCH	-2.20***	0.73	-3.02	0.003
Ent				
Gender	0.04	0.06	0.75	0.454

Age	-0.01***	0.00	-3.25	0.001
Ln(Family size)	-0.11**	0.06	-1.98	0.048
Employment	-0.01	0.05	-0.14	0.887
Elementary school	-0.05	0.06	-0.86	0.392
Middle school	0.08	0.06	1.31	0.191
High/ vocational school	0.04	0.09	0.41	0.685
College or above	0.56***	0.21	2.64	0.008
Unmarried	0.69	0.44	1.58	0.115
Married	0.41	0.42	0.97	0.333
Divorced	0.60	0.47	1.29	0.197
Widow	0.52	0.43	1.21	0.225
Insurance	-0.04	0.08	-0.50	0.620
Ethnicity	0.02	0.08	0.31	0.759
Self-rated health Worse	0.02	0.05	0.47	0.639
Self-rated health Better	-0.06	0.07	-0.81	0.417
Ln(Total household expenditure)	-0.01	0.10	-0.13	0.897
Ln(Total household expenditure)*2	0.00	0.01	0.75	0.456
Drinking	0.09*	0.05	1.74	0.082
LTCH	0.13**	0.06	2.08	0.038
MTCH	0.09*	0.06	1.66	0.096
HTCH	0.17**	0.07	2.29	0.022

Note: Asterisks*** indicates statistical significance at the 1% level, ** at the 5% level, * at the 10% level.

Source: Author

Table C2 Tobacco Consumption Impact on Rural Household Expenditure in Rural China (Three Waves 2010, 2012, 2014)

	Coef.	Std. Err.	Z	P>|z|
Dress				
Gender	-0.34	0.27	-1.25	0.211
Age	-0.09***	0.01	-9.01	0.000
Ln(Family size)	2.68***	0.24	11.26	0.000
Employment	0.22	0.20	1.08	0.281
Elementary school	0.49*	0.27	1.82	0.068
Middle school	0.79***	0.28	2.84	0.004
High/ vocational school	1.62***	0.39	4.10	0.000
College or above	1.70*	0.95	1.78	0.074
Unmarried	6.49***	1.70	3.81	0.000
Married	6.09***	1.62	3.76	0.000
Divorced	5.70***	1.85	3.09	0.002
Widow	6.40***	1.66	3.86	0.000
Insurance	1.34***	0.33	4.02	0.000
Ethnicity	2.17***	0.36	6.11	0.000
Self-rated health				
Worse	-1.39***	0.20	-6.94	0.000
Self-rated health				
Better	-1.14***	0.29	-3.88	0.000
Ln(Total household expenditure)	3.64***	0.38	9.63	0.000
Ln(Total household expenditure)*2	-0.35***	0.02	-16.10	0.000
Drinking	0.28	0.21	1.34	0.181
LTCH	-0.57**	0.27	-2.14	0.032

MTCH	0.03	0.24	0.14	0.887
HTCH	1.18***	0.32	3.71	0.000

House				
Gender	0.41	0.46	0.88	0.379
Age	0.22***	0.02	13.37	0.000
Ln(Family size)	-4.79***	0.42	-11.44	0.000
Employment	2.67***	0.37	7.22	0.000
Elementary school	-0.04	0.46	-0.08	0.934
Middle school	-0.10	0.47	-0.21	0.831
High/ vocational school	-0.91	0.68	-1.35	0.176
College or above	-3.11*	1.63	-1.91	0.057
Unmarried	8.89***	3.09	2.87	0.004
Married	9.46***	2.95	3.20	0.001
Divorced	9.32***	3.34	2.79	0.005
Widow	10.13***	3.02	3.36	0.001
Insurance	1.60**	0.62	2.59	0.010
Ethnicity	-1.31**	0.61	-2.17	0.030
Self-rated health				
Worse	-0.56	0.37	-1.52	0.129
Self-rated health				
Better	-0.76	0.55	-1.40	0.162
Ln(Total household expenditure)	-1.92***	0.69	-2.79	0.005
Ln(Total household expenditure)*2	0.17***	0.04	4.25	0.000
Drinking	0.30	0.38	0.79	0.430
LTCH	0.66	0.48	1.38	0.167
MTCH	0.03	0.43	0.07	0.942

HTCH	0.88	0.56	1.56	0.118

Daily				
Gender	0.87[*]	0.47	1.86	0.062
Age	-0.02	0.02	-1.24	0.216
Ln(Family size)	0.45	0.42	1.06	0.288
Employment	0.70[*]	0.38	1.85	0.065
Elementary school	0.37	0.46	0.80	0.423
Middle school	0.78	0.48	1.64	0.101
High/ vocational school	0.91	0.68	1.34	0.181
College or above	2.58	1.65	1.57	0.117
Unmarried	25.16[***]	3.14	8.01	0.000
Married	20.84[***]	3.00	6.94	0.000
Divorced	21.54[***]	3.39	6.35	0.000
Widow	21.57[***]	3.06	7.04	0.000
Insurance	-0.99	0.63	-1.58	0.114
Ethnicity	0.46	0.61	0.75	0.452
Self-rated health				
Worse	-1.02[***]	0.37	-2.73	0.006
Self-rated health				
Better	-0.30	0.56	-0.55	0.584
Ln(Total household expenditure)	-1.52[**]	0.70	-2.18	0.029
Ln(Total household expenditure)*2	0.11[***]	0.04	2.66	0.008
Drinking	1.36[***]	0.38	3.58	0.000
LTCH	0.05	0.48	0.09	0.924
MTCH	0.25	0.43	0.57	0.569
HTCH	0.42	0.57	0.74	0.458

	Health			
Gender	-0.84	0.70	-1.20	0.231
Age	0.34***	0.02	13.79	0.000
Ln(Family size)	-5.88***	0.60	-9.80	0.000
Employment	-4.10***	0.48	-8.47	0.000
Elementary school	-2.75***	0.68	-4.02	0.000
Middle school	-5.04***	0.71	-7.05	0.000
High/ vocational school	-5.48***	1.02	-5.38	0.000
College or above	-4.65*	2.46	-1.89	0.059
Unmarried	-13.47***	4.16	-3.24	0.001
Married	-11.51***	3.94	-2.92	0.003
Divorced	-16.40***	4.54	-3.62	0.000
Widow	-15.81***	4.04	-3.91	0.000
Insurance	-0.90	0.80	-1.12	0.263
Ethnicity	-1.96**	0.92	-2.13	0.033
Self-rated health				
Worse	4.16***	0.48	8.58	0.000
Self-rated health				
Better	2.32***	0.71	3.27	0.001
Ln(Total household expenditure)	5.18***	0.92	5.62	0.000
Ln(Total household expenditure)*2	-0.19***	0.05	-3.51	0.000
Drinking	-2.80***	0.51	-5.48	0.000
LTCH	-0.37	0.66	-0.56	0.578
MTCH	-1.80***	0.60	-2.98	0.003
HTCH	-4.83***	0.79	-6.12	0.000
	Trco			

Gender	0.53	0.45	1.18	0.238
Age	-0.16***	0.02	-10.25	0.000
Ln(Family size)	2.40***	0.39	6.15	0.000
Employment	1.48***	0.32	4.61	0.000
Elementary school	0.96**	0.44	2.18	0.029
Middle school	1.66***	0.46	3.62	0.000
High/ vocational school	1.88***	0.65	2.87	0.004
College or above	4.13***	1.58	2.61	0.009
Unmarried	-2.45	2.75	-0.89	0.372
Married	-3.70	2.61	-1.42	0.156
Divorced	0.39	2.99	0.13	0.895
Widow	-3.62	2.67	-1.35	0.176
Insurance	-0.15	0.53	-0.28	0.781
Ethnicity	3.42***	0.59	5.79	0.000
Self-rated health				
Worse	-0.15	0.32	-0.48	0.632
Self-rated health				
Better	0.26	0.47	0.55	0.583
Ln(Total household expenditure)	9.61***	0.61	15.77	0.000
Ln(Total household expenditure)*2	-0.74***	0.04	-21.22	0.000
Drinking	0.64*	0.34	1.89	0.058
LTCH	-0.06	0.43	-0.14	0.886
MTCH	1.28***	0.39	3.25	0.001
HTCH	3.99***	0.52	7.73	0.000
Edu				
Gender	-0.43	0.68	-0.63	0.529

Age	-0.23***	0.02	-9.91	0.000
Ln(Family size)	6.24***	0.55	11.39	0.000
Employment	-0.61	0.41	-1.49	0.136
Elementary school	0.96	0.66	1.46	0.143
Middle school	1.89***	0.69	2.72	0.006
High/ vocational school	2.34**	0.99	2.37	0.018
College or above	-1.60	2.38	-0.67	0.502
Unmarried	-12.80***	3.58	-3.57	0.000
Married	-10.15***	3.36	-3.02	0.003
Divorced	-9.83**	3.95	-2.49	0.013
Widow	-6.51*	3.48	-1.87	0.061
Insurance	-1.32**	0.67	-1.97	0.049
Ethnicity	-3.32***	0.90	-3.69	0.000
Self-rated health				
Worse	-1.02**	0.41	-2.48	0.013
Self-rated health				
Better	-0.27	0.59	-0.46	0.645
Ln(Total household expenditure)	3.82***	0.79	4.81	0.000
Ln(Total household expenditure)*2	-0.07*	0.05	-1.65	0.099
Drinking	-0.01	0.44	-0.03	0.974
LTCH	0.59	0.59	1.01	0.312
MTCH	0.42	0.54	0.77	0.441
HTCH	-2.14***	0.71	-3.02	0.003
Ent				
Gender	0.05	0.06	0.88	0.381
Age	-0.01***	0.00	-4.50	0.000

Ln(Family size)	-0.08	0.05	-1.55	0.120
Employment	-0.08	0.05	-1.59	0.111
Elementary school	-0.08	0.06	-1.47	0.142
Middle school	0.09	0.06	1.60	0.110
High/ vocational school	0.10	0.08	1.21	0.227
College or above	0.64***	0.20	3.15	0.002
Unmarried	0.37	0.41	0.92	0.357
Married	0.09	0.39	0.22	0.826
Divorced	0.39	0.44	0.89	0.375
Widow	0.14	0.40	0.36	0.718
Insurance	-0.07	0.08	-0.85	0.394
Ethnicity	0.01	0.08	0.09	0.925
Self-rated health Worse	0.02	0.05	0.40	0.686
Self-rated health Better	-0.04	0.07	-0.61	0.544
Ln(Total household expenditure)	0.15*	0.09	1.72	0.086
Ln(Total household expenditure)*2	-0.01	0.01	-1.33	0.184
Drinking	0.08	0.05	1.54	0.123
LTCH	0.06	0.06	1.00	0.317
MTCH	0.06	0.06	1.00	0.316
HTCH	0.21***	0.07	2.88	0.004

Note: Asterisks*** indicates statistical significance at the 1% level, ** at the 5% level, * at the 10% level.

Source: Author

APPENDIX D

Table D1 Tobacco Consumption Impact on self-rated health in Rural China by the Random Effects Ordered Probit Regression

	Coef.	Std. Err.	Z	P>|z|
Gender	0.19***	0.03	7.15	0.000
Age	-0.02***	0.00	-27.59	0.000
Family size	0.00	0.00	0.26	0.796
Employment	0.00	0.02	0.04	0.968
Elementary school	0.06**	0.02	2.44	0.015
Middle school	0.09***	0.02	3.89	0.000
High/ vocational school	0.07**	0.04	2.08	0.037
College or above	-0.04	0.07	-0.67	0.501
Unmarried	0.37**	0.17	2.24	0.025
Married	0.16	0.16	1.01	0.313
Divorced	-0.03	0.19	-0.18	0.856
Widow	0.18	0.17	1.07	0.283
Insurance	-0.02	0.03	-0.91	0.361
Low income	-0.06***	0.02	-3.23	0.001
High income	0.09***	0.02	4.77	0.000
NS	0.09***	0.03	3.04	0.002
LTCI	0.02	0.03	0.77	0.440
HTCI	-0.11**	0.04	-2.34	0.019
ES	0.09***	0.03	2.71	0.007
Ethnicity	0.10***	0.03	3.39	0.001

Note: Asterisks*** indicates statistical significance at the 1% level, ** at the 5% level.

Source: Author

Table D2 Tobacco Consumption Impact on self-rated health in Rural China by
the Random Effects Generalized Ordered Probit Regression

	Coef.	Std. Err.	Z	P>|z|
Self-rated Health 0 vs. 1-2				
Gender	0.29***	0.03	9.29	0.000
Age	-0.03***	0.00	-34.58	0.000
Family size	0.00	0.01	0.64	0.523
Employment	0.00	0.02	-0.18	0.855
Elementary school	0.11***	0.03	4.36	0.000
Middle school	0.21***	0.03	7.69	0.000
High/ vocational school	0.19***	0.04	4.58	0.000
College or above	0.25***	0.09	2.86	0.004
Unmarried	0.40**	0.20	2.03	0.042
Married	0.09	0.19	0.50	0.619
Divorced	-0.11	0.22	-0.49	0.624
Widow	0.18	0.19	0.91	0.364
Insurance	0.04	0.03	1.38	0.166
Low income	-0.05**	0.02	-2.11	0.035
High income	0.10***	0.02	4.84	0.000
NS	0.11***	0.04	3.02	0.003
LTCI	0.03	0.03	0.98	0.325
HTCI	-0.12**	0.05	-2.29	0.022
ES	0.07*	0.04	1.74	0.082
Ethnicity	0.16***	0.03	4.57	0.000
Cons	1.44***	0.20	7.18	0.000
Self-rated Health 0-1 vs. 2				
Gender	0.07**	0.03	2.13	0.033

Age	-0.01***	0.00	-6.70	0.000
Family size	0.00	0.01	-0.08	0.937
Employment	-0.02	0.02	-0.84	0.400
Elementary school	-0.08***	0.03	-2.61	0.009
Middle school	-0.13***	0.03	-3.93	0.000
High/ vocational school	-0.17***	0.05	-3.49	0.000
College or above	-0.52***	0.09	-5.52	0.000
Unmarried	0.61**	0.25	2.46	0.014
Married	0.21	0.24	0.86	0.391
Divorced	-0.03	0.28	-0.11	0.909
Widow	0.18	0.25	0.72	0.470
Insurance	-0.13***	0.04	-3.64	0.000
Low income	-0.07***	0.03	-2.61	0.009
High income	0.07***	0.03	2.69	0.007
NS	0.12***	0.04	2.79	0.005
LTCI	0.03	0.04	0.78	0.436
HTCI	-0.13*	0.07	-1.89	0.059
ES	0.15***	0.05	3.22	0.001
Ethnicity	0.01	0.04	0.13	0.896
Cons	-1.21***	0.26	-4.72	0.000

Note: Asterisks*** indicates statistical significance at the 1% level, ** at the 5% level, * at the 10% level.

Source: Author

VITA

PERSONAL DATA

Name   Changle Li

Date of Birth   August 10, 1986

Place of Birth   Inner Mongolia, China

Email   lichangle2010@sina.com

EDUCATION

2006-2011   Bachelor of Science in Applied Psychology

                 Inner Mongolia Medical University

                 Huhhot, Inner Mongolia, China

2011-2012   Master of Science in Health Economics

                 Chulalongkorn University

                 Bangkok, Thailand

JOB EXPERIENCE

2010 -2011   Trainee

                 Baogang No.3 Hospital

                 Baotou, Inner Mongolia, China

2012- now   Lecturer

                 School of Health Management, Inner Mongolia
Medical University

                 Huhhot, Inner Mongolia, China