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DISSERTATION

Old-Age Disability in China

Implications for Long-Term Care Policies in the Coming Decades

Jianhui Hu

This document was submitted as a dissertation in March 2012 in partial fulfillment of the requirements of the doctoral degree in public policy analysis at the Pardee RAND Graduate School. The faculty committee that supervised and approved the dissertation consisted of Megan Beckett (Chair), Lisa Shugarman, and Paul Heaton.

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ABSTRACT

China's population is aging rapidly. The increase in the elderly population, along with the rising prevalence of major chronic diseases and greater longevity among those afflicted with many of these diseases, will lead to a growing number of functionally disabled elders who may need long-term care (LTC). Elders in China have traditionally relied on their families as the main source of LTC. This situation is changing as fewer family members are available to provide care, due to shrinking family size caused by continuously low fertility, combined with increased female workforce participation. Without a well designed LTC system to address the growing care need, it is increasingly obvious that the current LTC situation in China will not be sustainable in the coming decades.

Old-age disability and LTC have not yet been well studied in China. Using logistic regressions and a prevalence ratio projection model, and considering international practices, this dissertation addresses three research questions: 1) What are the key risk factors for old-age disability in China? 2) What are the projected numbers of older adults with disabilities in China in future decades through 2050? 3) How can China develop a feasible and sustainable LTC delivery and financing system to address projected growth in LTC needs of this population over the next four decades?

Findings indicate that old age, being female, single, and in poor health (e.g., presence of a chronic condition and poor self-rated health) are the key risk factors associated with functional disability among older adults in China. Although urban older adults are more likely to be severely disabled, the overall disability risk is higher among rural older adults. No matter whether disability rates remain constant, increase or decline in the future, the sheer number of disabled older adults and the ratio of disabled elders to potential caregivers (however defined) will increase rapidly, especially in rural areas. I describe how my findings, combined with an understanding of common features of existing LTC systems and international guidelines can inform strategies policymakers can use to develop a feasible and sustainable LTC system to prepare for its growing care needs in the future.

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GLOSSARY

AARP	American Association of Retired Persons
ADL	Activity of Daily Living
BURDIS	Burden of Disease Network Project
CHARLS	Chinese Health and Retirement Longitudinal Study
CHNS	China Health and Nutrition Survey
CLHLS	Chinese Longitudinal Healthy Longevity Survey
CSSD	China Sample Survey on Disability
DALY	Disability-Adjusted Life Years
GDP	Gross Domestic Product
HCBS	Home and Community-Based Services
HRS	Health and Retirement Survey
IADL	Instrumental Activity of Daily Living
IDB	International Database
KLoSA	Korean Longitudinal Study of Aging
LTC	Long-Term Care
LTCI	Long-Term Care Insurance
MHAS	Mexican Health and Aging Study
NIA	National Institute on Aging
OECD	Organization for Economic Co-operation and Development
OR	Odds Ratio
PACE	Program of All-Inclusive Care for the Elderly
RRR	Relative-Risk Ratio
SES	Socioeconomic Status
SRB	Sex-Ratio at Birth

SSAPUR	Sample Survey on Aged Population in Urban/Rural China
UK	United Kingdom
UN	United Nation
U.S.	United States
WHO	World Health Organization

CHAPTER ONE Understanding Old-Age Disability and Long-Term Care (LTC) in China

1.1 Introduction: What are Old-Age Disability and Long-Term Care (LTC)?

1.1.1 Old-age disability

In developed countries, old-age disability is often defined in terms of needing help or having difficulties in performing one or more of the activities of daily living (ADLs) or instrumental activities of daily living (IADLs) (National Research Council, 2009; Heikkinen, 2003). Activities of daily living, such as bathing, dressing, eating, moving around, and using the bathroom are generally considered the classic measurements for disability. They are widely used in discussions of long-term care (LTC) in the literature to assess disability. They are also used to determine eligibility for benefits in the United States (U.S.) and in many European countries (Stallard, 1999; Heikkinen, 2004). Instrumental activities of daily living, such as shopping, cooking, housekeeping, taking medications, using public transportation, and managing money measure less severe levels of disability, but are associated with the elders' ability to live independently in the community.[1]

Although the measurement of ADLs has been generally consistent across different countries and in different time periods, the measurement of IADLs has been less consistent cross-culturally; surveys reflect cultural/geographical/temporal variations in those activities that are considered instrumental to daily living. As an illustration, Table 1.1 presents the ADL and IADL items included in national surveys across four countries (U.S., Korea, China, and Mexico). Across

[1] Assessing disability has been taking two approaches in the West: a medical view and a social view. The medical view ties disability to underlying health conditions (e.g., specific diseases) and focuses on pathologies; the social view considers disability as the product of the physical, organizational, and attitudinal barriers in society (National Research Council, 2009). The measures of ADLs and IADLs capture more of the social/cultural aspects of disability.

these four surveys, ADL items are consistently measured while measurements of the IADL items vary.

Table 1.1 ADL and IADL Items in Selected National Surveys

Country	Survey	ADL Items	IADL Items
U.S.	Health and Retirement Study (HRS)	1. bathing 2. dressing 3. eating 4. walking across a room 5. getting in/out of bed 6. using the toilet	1. using the telephone 2. taking medication 3. handling money 4. shopping for groceries 5. preparing meals 6. using a map
Korea	Korean Longitudinal Study of Aging (KLoSA)	1. dressing 2. bathing 3. eating 4. using the toilet 5. getting in/out of bed, walking across room	1. using the telephone 2. managing money 3. taking medication 4. shopping for groceries 5. preparing a hot meal
China	Chinese Health and Retirement Longitudinal Study (CHARLS)*	1. dressing 2. bathing/showering 3. cutting food 4. going to the bathroom 5. controlling urination and defecation 6. getting in/out of bed	1. doing household chores 2. preparing hot meals 3. shopping for groceries 4. managing money 5. making phone calls 6. taking medications
Mexico	Mexican Health and Aging Study (MHAS)**	1. walking across a room 2. bathing/showering 3. eating/cutting food 4. getting into/out of bed 5. using the toilet	1. preparing a hot meal 2. shopping for groceries 3. taking medications 4. managing money

Notes:

* This categorization is based on Strauss (2010). They also used the following "physical activities" items: walking for 100 m, stooping, kneeling, crouching, extending arms above shoulder level, lifting weights like a heavy bag, etc.

** The survey grouped "dressing" under functionality. Other functionality measures are: walking one or several blocks, running/jogging one kilometer, sitting for 2 hours, getting up from a chair, etc.

In China, old-age disability has been measured using ADLs (Zimmer, 2004; Gu, 2004; Liang, 2001) and other physical functionality measures, such as difficulty walking a certain distance or lifting a certain weight (Zimmer, 2010); IADLs have been introduced gradually too in recent years (Strauss, 2010; Beydoun, 2005).

1.1.2 Long-term care (LTC)

Long-term care (LTC) refers to the range of medical (e.g., skilled nursing care) and nonmedical (e.g., personal care) services provided to persons with chronic disabilities or to persons who, because of physical or cognitive impairments, are unable to meet their own daily medical, personal, and social needs. Most of these services involve assistance with ADLs and/or IADLs. Long-term care services can be offered in an institutional setting (e.g., nursing homes), community setting, or in the home; they can be provided by formal (paid) or informal (unpaid) care providers. Although formal care provided by LTC professionals, such as nurses and social workers is important, informal care from family members, neighbors, and friends represents the majority of all LTC services provided throughout the world (Organization for Economic Co-operation and Development, 2011; World Health Organization, 2003).

People age 65 and over (hereafter referred to as "older adults"), and especially those over 80 (hereafter referred to as the "oldest old"), have the highest probability of receiving LTC services (Organization for Economic Co-operation and Development, 2011). It is estimated that in the U.S., approximately 70% of older adults eventually will need some type of LTC at some point in their lives. On average, they will need LTC for three years before they die, and 20% of older adults will need care for more than five years (Kemper, 2005/2006).[2] Because LTC need is generally concentrated among persons age 65 and over, this dissertation will focus on this older age group. Long-term care for younger people with developmental disabilities or mental disorders is beyond the scope of this study.

1.2 Background: LTC is an Urgent Policy Issue in Many Countries

[2] LTC need is defined differently across countries, programs, and populations, but it generally involves the presence of one or more ADL impairments or several IADL impairments. In Kemper (2005/2006), it is defined as "having one or more ADL limitations, four IADL limitations, or using formal LTC services other than strictly post-acute care." Total number of years of LTC need refers to the need of facility care, formal home care services, or informal care at home.

Long-term care for disabled older adults has become an urgent policy issue in many developed countries (e.g., the Organization for Economic Co-operation and Development, or OECD)[3] and increasingly in developing countries due to their rapidly aging populations with growing chronic disease burdens. There is increasing concern about the ability of current LTC systems to keep pace with the growth of aging populations in their need for LTC services (OECD, 2011; Merlis, 2000).

In 2006, there were 500 million older adults worldwide; this number is projected to reach 1 billion by 2030, corresponding to one out of eight people worldwide (National Institute on Aging, 2007). Globally, the percentage of the oldest old will nearly triple in the next 40 years (United Nations, 2009). At the same time that both the total number of older adults and the total burden of disease are rising, so too is the number of years that people can expect to live with disability and hence be at-risk for needing LTC services.

Systematic information on LTC need and supply across countries is scarce. In the developed world, such information is available for the OECD countries; information from the developing world comes mainly from a series of World Health Organization (WHO) studies conducted in the early 2000s (WHO, 2002a, 2002c, 2002d, 2003).

Of particular concern is the fact that the number of family members and other informal care providers is not keeping up with the need (OECD, 2011; World Bank, 2011; WHO, 2002b, 2003). Informal care provided by family members, especially women, has traditionally been the main source of LTC in most countries (OECD, 2011; Tjadens, 2011; WHO, 2003). Reliance on

[3] The Organization for Economic Co-operation and Development (OECD) is an international economic organization founded in 1961 to stimulate economic co-operation and world trade. It has 34 member countries which include both European and non-European high-income countries, such as the United Kingdom (UK), Germany, Australia, Canada, U.S., South Korea, Japan, etc.

informal care reflects, in part, older adults' preference for independent living in the home or the community for as long as possible. Yet shrinking family size due to continuously low fertility, combined with increased female workforce participation has meant that there are fewer daughters (and sons) able to provide informal care to their elderly parents in many developed and developing countries (OECD, 2011; World Bank, 2011; Zeng, 2010; WHO, 2003).

Expanding formal care in institutions is expensive. For example, in the U.S., although only 3.3% and 14% of older adults and the oldest old, respectively, were institutionalized, 57% of Medicaid LTC expenditures occurred in institutional settings on average across the states (Burwell, 2009).[4] Long-term care expenditures, excluding the value of informal care,[5] currently account for 1.5% of gross domestic product (GDP) on average across the OECD (OECD, 2011); it has been estimated that the percentage will more than double by 2050. Taking into consideration the declining availability of informal care, which is expected to be replaced, at least partly, by formal care, it is feasible that LTC expenditures among OECD countries could account for up to 20% of GDP by 2050 (OECD, 2011), whether provided in an institution or in a community setting.

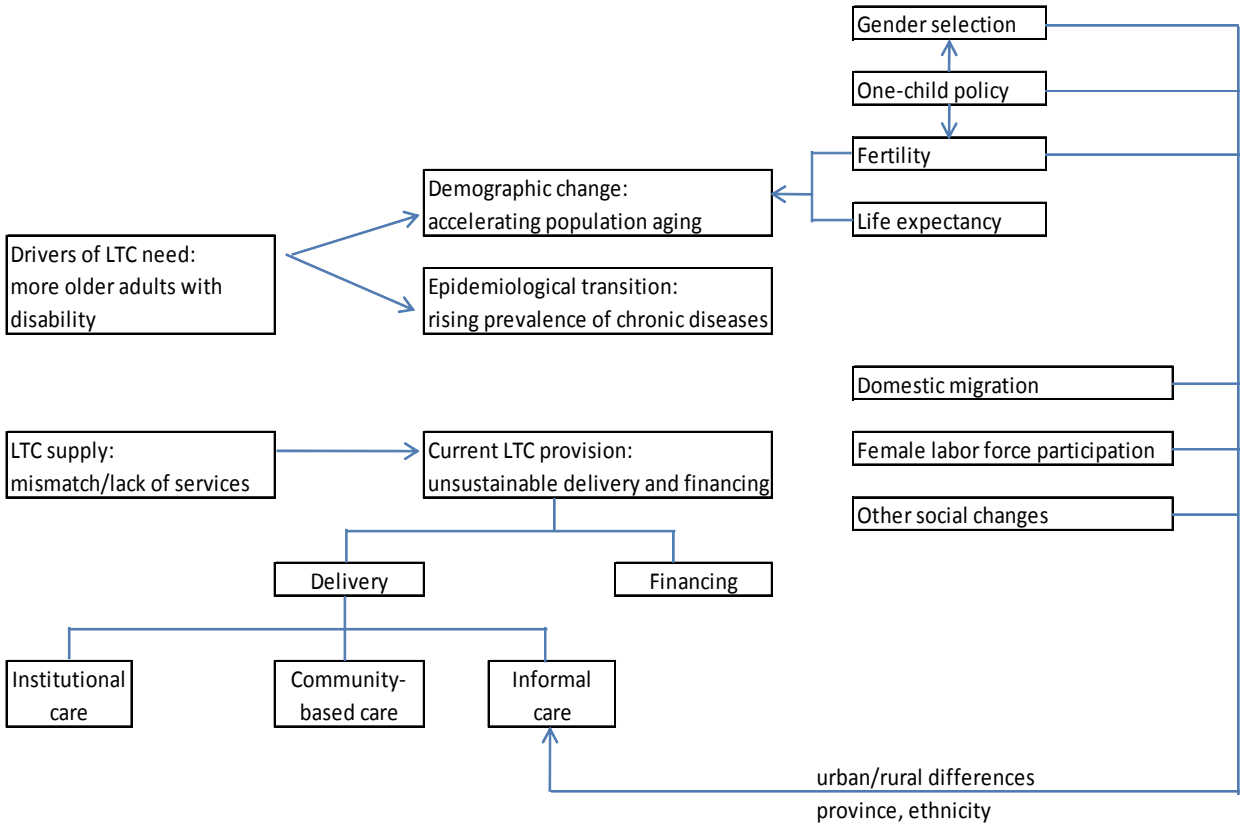
1.3 Policy Issue: China Lacks a National LTC Delivery and Financing System to Provide Care to Meet Its Growing Needs

[4] Medicaid is a health program for people and families with low incomes, jointly funded by the state and federal governments and managed by the individual states. It is the largest source of funding for medical and health-related services for people with limited income in the U.S..

[5] The economic value of informal care is huge: in the U.S., the unpaid care provided by 34 million family caregivers was an estimated $375 billion in 2007, compared to $97 billion of Medicaid LTC expenditure in the same year; the number increased to $450 billion in 2009 (AARP, 2011).

China is currently facing many of the challenges discussed above.[6] Moreover, there are several reasons to expect that these challenges will be even greater in China than elsewhere (see Figure 1.1).

Figure 1.1 Challenges to the Current LTC Situation in China

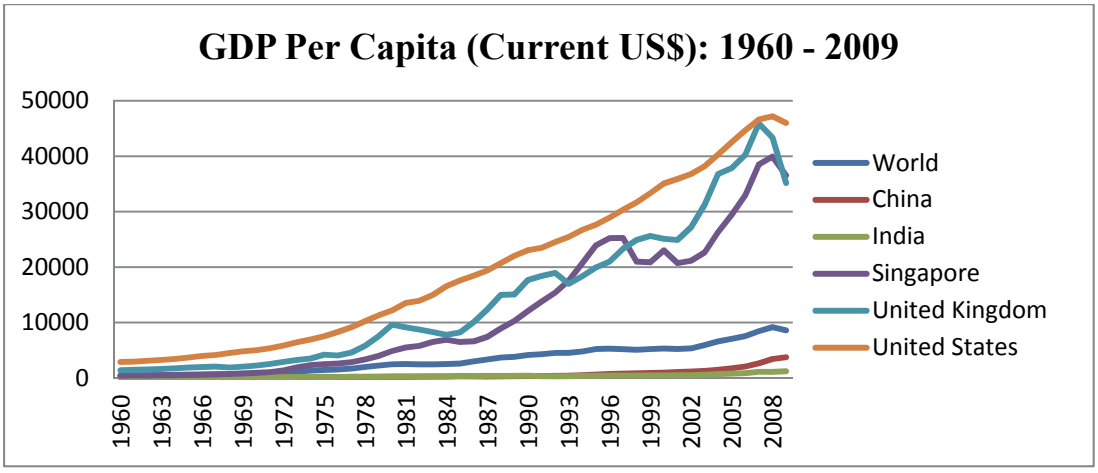


First, population aging in China is happening more rapidly and dramatically than in many developed and developing countries (He, 2007; Jackson, 2004). Second, the prevalence of major chronic conditions is rising fast (WHO, 2008). This leaves more and more disabled older adults with LTC needs. Third, the availability of informal care is declining faster than in many other countries due to the one-child policy strictly implemented in the 1980s (Zeng, 2010). Fourth, compared to the developed countries that usually build or reform their LTC system within a

[6] This study focuses on mainland China.

well-developed healthcare system (United Nations, 2007), China's healthcare system is still underdeveloped and ill prepared to deal with an aging population. Institutional care is in poor supply. Inasmuch as China is still a low-income country in terms of GDP per capita, it has limited public resources to expand its health and LTC systems, despite its rapid economic growth in recent decades (see Figure 1.2). In fact, China may be the first major country to grow old before it grows rich (Jackson, 2004).

Figure 1.2 GDP Per Capita (Current US$): 1960 – 2009



Source: The World Bank, 2011

As in Western countries, there are marked disparities between urban/rural areas,[7] across provinces,[8] and among different ethnic groups,[9] with regard to life style, socioeconomic status (SES), access to care, and infrastructure. Compared to rural residents, urban Chinese are

[7] In China, residence can be divided into three broad categories: city, town, and rural area. Town refers to a semi-urban marginal area that used to be part of the rural areas but has been developing rapidly due to fast urbanization. Together with cities, towns have been considered "urban areas" in many China studies.

[8] There are 31 provinces in mainland China (including 4 provincial level cities but excluding the Hong Kong Special Administrative Region). Provinces along the East Coast (e.g., Shanghai, Zhejiang, Jiangsu, and Guangdong) are generally more economically developed than the west inland provinces (e.g., Guangxi, Yunnan, and Shannxi).

[9] There are 56 ethnic groups in China and Han Chinese is the largest one, constituting approximately 92% of the population in mainland China (National Bureau of Statistics of China, 2011). Major minority groups are the Zhuang, Man, and Hui. A large proportion of minority people live in southwest and northwest inland China.

significantly advantaged in terms of income, education, social engagement and support, access to care, quality of care received, health behaviors, and health knowledge and awareness (Wu, 2009; Chu, 2008; Zimmer, 2004). Urban areas have much better developed and larger health care infrastructure and access to manpower. Disparities also exist across different provinces and different ethnic groups, usually favoring those who live in the more developed provinces along the East and South Coasts (relative to the west and inland provinces) and the Han people (relative to minority groups such as the Zhuang, Man, and Hui) (Chu, 2008).

There are reasons to suspect that China will face very serious LTC challenges in the coming years, and that older adults living in rural areas and the non-Han Chinese may suffer the most, given their disadvantages. Currently China does not have a national LTC delivery and financing system. Without such a system, these issues are likely to be left unaddressed, and China's LTC situation may worsen in the coming decades.

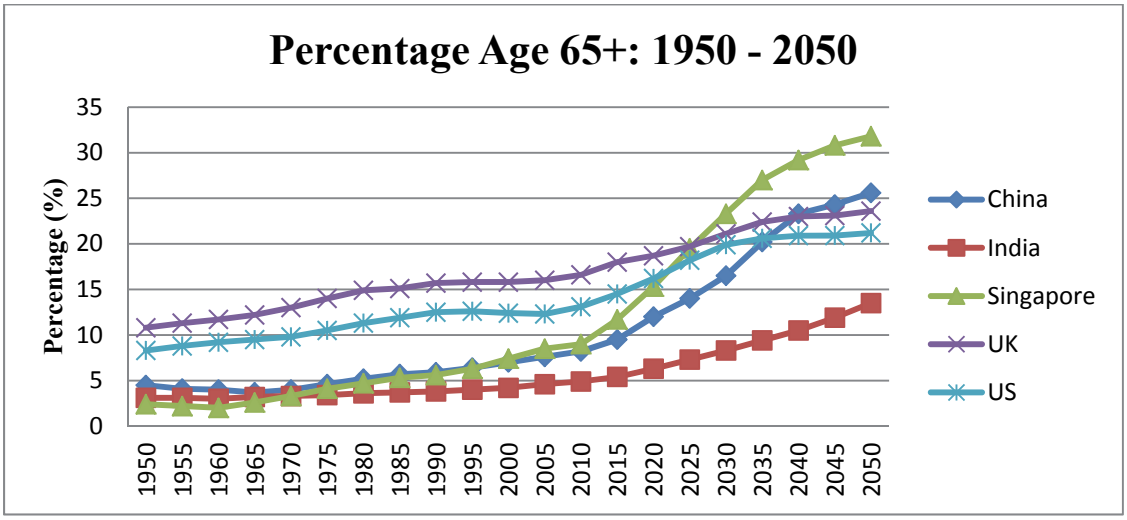
1.3.1 Demographic change: accelerating population aging

China's population (currently 1.3 billion) is amongst the most rapidly aging in the world. Since 2000, when China first met the United Nations (UN) "aging society" definition,[10] the proportion of older adults has increased 2 percentage points to 8.9% of the population, while the proportion of people 14 years and under plunged 6.3 percentage points to 16.6% (National Bureau of Statistics of China, 2011). In the next 40 years, the aging of China's population is projected to accelerate, with the oldest old segment of the population growing the fastest, from 1.4% in 2010 to 7.6% by 2050 (UN, 2011). Figures 1.3 and 1.4 show percentages of older adults and the oldest old relative to the total population, from 1950 to 2050, in five countries at different stages

[10] The United Nations (UN) classifies a country as an aging society and a super-aging society if the proportion of its older adults is over 7% and 14% of the total population, respectively.

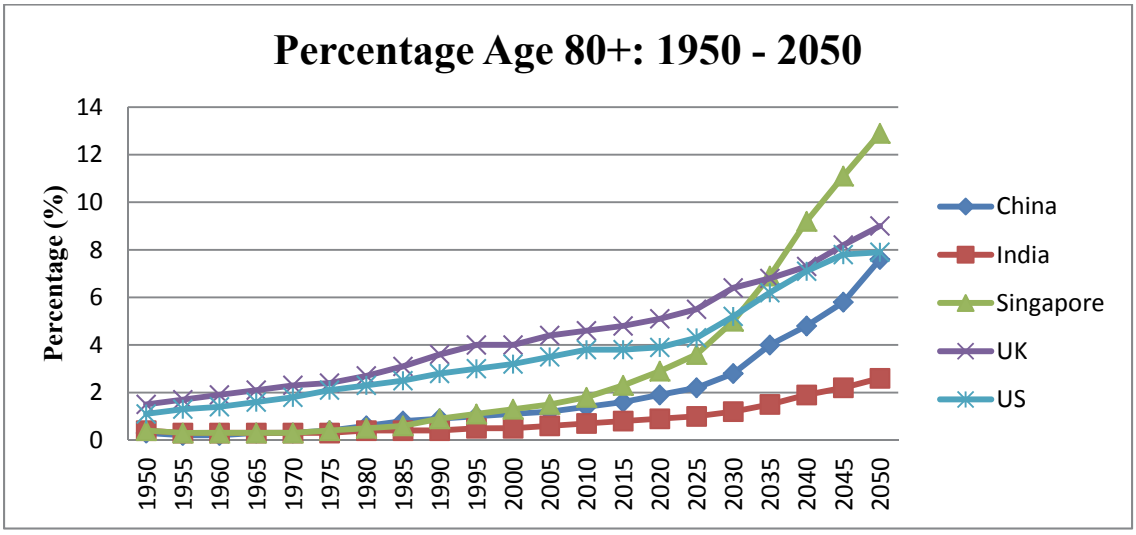
of economic development and with different segments of the population aging. In less than 30 years, China will have an older population (in terms of percentage of older adults) than the United Kingdom (UK), an aging nation in the developed world.

Figure 1.3 Percentages 65+ in Total Population: 1950 – 2050



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2010 Revision

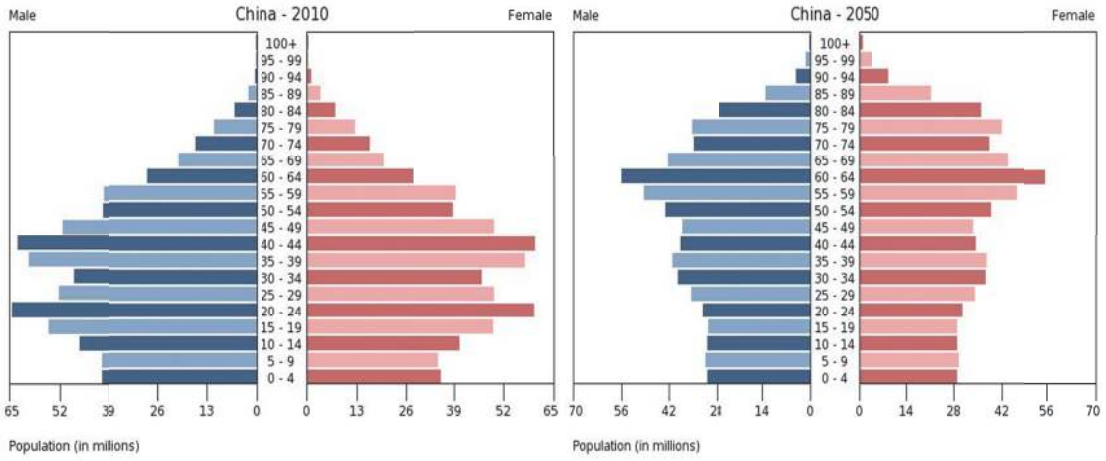
Figure 1.4 Percentages 80+ in Total Population: 1950 – 2050



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2010 Revision

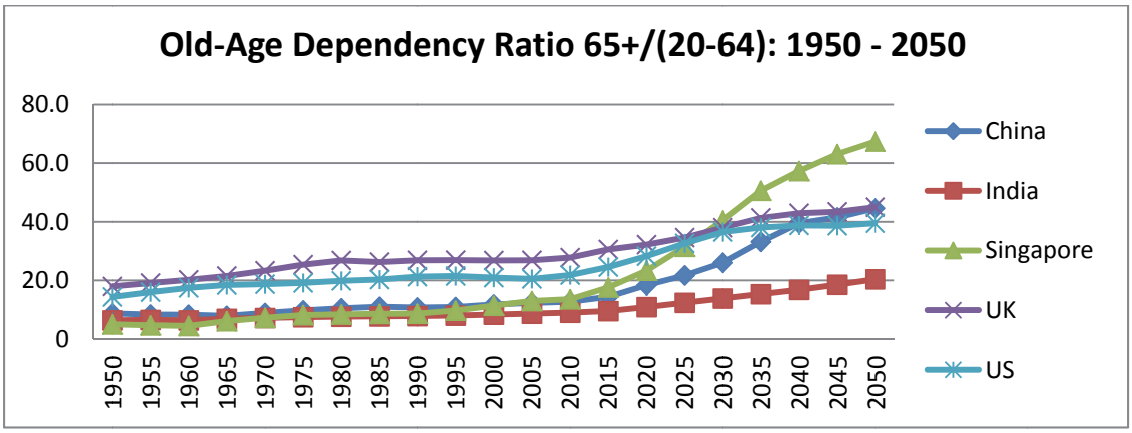
Although the size of the elderly population keeps growing, the growth of working-age population available to support Chinese older adults is slowing down; the number of working-age adults is projected to start declining in 2020 (UN, 2011). This will lead to a rapid increase in old-age dependency ratios in the coming decades (see Figures 1.5 and 1.6) from 2010 to 2050, the number of older adults per 100 persons of working age (20 – 64) is projected to increase by 251%; it is projected to increase by 81% and 62% for the same period in the U.S. and the UK, respectively.

Figure 1.5 Population Pyramids of China: 2010 and 2050



Source: U.S. Census Bureau, International Database

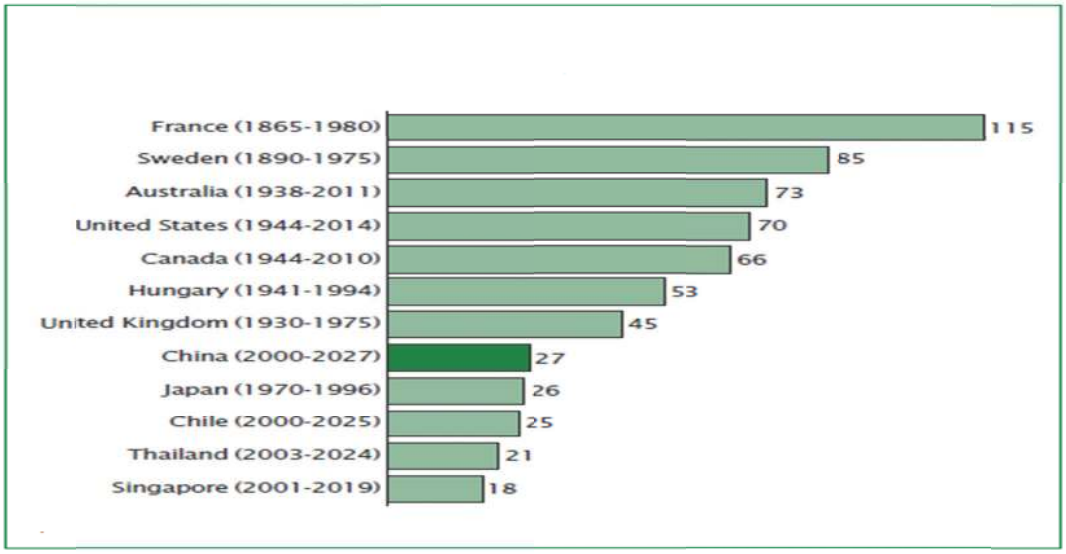
Figure 1.6 Old-Age Dependency Ratio 65+/(20-64): 1950 – 2050



Source: United Nations, Department of Economic and Social Affairs, Population Division (2011).

With this growth rate, China is projected to join the other "super-aging" societies in 27 years. By comparison, it took 115 years for France to transition from an aging to super-aging society and it is believed that it will take 70 years for the U.S. to complete this process (He, 2007) (see Figure 1.7).

Figure 1.7 Speed of Population Aging: Number of Years Required or Expected for Percent of Population Age 65+ to Rise from 7 Percent to 14 Percent

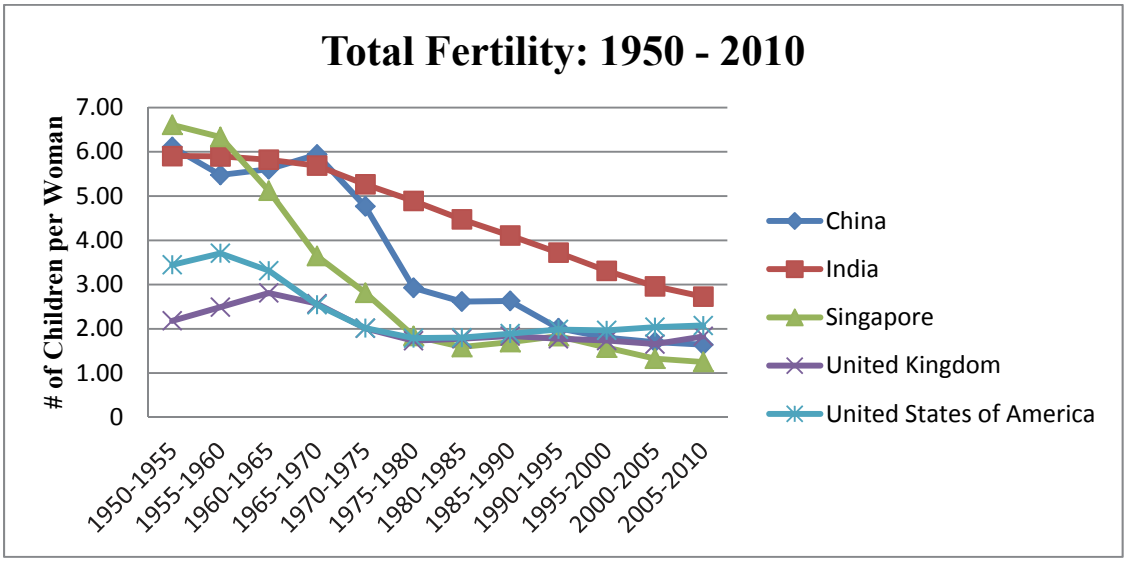


Source: Kinsella and Velkoff, 2001; U.S. Census Bureau, 2006

Two major factors contribute to the rapid aging of China's population. First, over the past 60 years, advances in healthcare and nutrition led to a nearly doubled life expectancy from 44 years in the 1950s to 73 years in 2010 (UN, 2011). Second, the one-child policy implemented in 1979 has resulted in a steep decline in fertility rates, from 6.1 in the 1950s to 2.9 in the 1970s and further down to 1.6 in 2010 (UN, 2011) (see Figure 1.8). Consequently, the "4-2-1" family structure (four grandparents, two adult children, one grandchild) is common in contemporary China, with serious implications for the availability of informal sources of support for older adults. At the same time, there is a gender imbalance in births due to the preference for boys: the

sex-ratio at birth (SRB) between male and female births in China reached 117:100 in 2000 (Chen, 2005), substantially above the natural SRBs between 103:100 and 107:100 (Chahnazarian, 1988; Waldron, 1998). This ratio climbed further, reaching 119:100 in 2005 and 130:100 in some rural areas (Wu, 2009). This will lead to fewer daughters or daughters-in-law to provide care in the future (Jackson, 2004). The full effect of these demographic changes will be especially evident starting in 2020, when the cohort of parents who had children under the one-child policy begins to turn 65.

Figure 1.8 Total Fertility Change: 1950 – 2010



Source: United Nations, Department of Economic and Social Affairs, Population Division (2011). World Population Prospects: The 2010 Revision.

1.3.2 Epidemiological transition: rising prevalence of chronic diseases

Chronic conditions are among the primary risk factors for old-age disability in China (He, 2007). The prevalence of most chronic diseases is still low when compared with developed countries. However, China is fast catching up, shifting the disease burden from acute to noncommunicable conditions in a remarkably short time (Zhu, 2011). For a country with a population of 1.3 billion,

even a slight increase in prevalence rates translates into a large absolute number of the chronically ill.

Chronic diseases now account for an estimated 80% of total deaths and 70% of disability-adjusted life years (DALYs) lost in China. The leading causes of both death and morbidity are cardiovascular diseases, chronic respiratory disease, and cancer (Wang, 2005). The overweight population is growing: in 2004, almost one in four of all Chinese adults were overweight (Popkin, 2008). With the increase in the prevalence of overweight and obesity, obesity-related chronic conditions (e.g., hypertension, cardiovascular diseases, and type II diabetes) also increased over the past decade. During the period from 1990 to 2003, the mortality rate and contribution (as a percentage) to the total death rate of obesity-related chronic disease increased, particularly, in rural areas (Wang, 2007). Exposure to risk factors is high: more than 300 million men smoke cigarettes and 160 million adults are hypertensive, most of whom are not being treated (Wang, 2005). Although more than half of older Chinese reported a chronic condition, the prevalence of chronic diseases is higher in urban than rural areas, and is more commonly reported by those age 70 and over than by those age 60 to 69 (He, 2007). A larger proportion of older adults with higher income report chronic conditions than those with middle or low income, as more affluent people are classified as obese (Zhu, 2011; He, 2007).

1.3.3 Old-age disability: more older adults are living with disability

The fast-growing number of older adults in the society and the increasing prevalence of major chronic diseases have left a large number of older adults with disabilities, and this number is continuously growing. According to Wang Zhenyao, Director of Social Welfare and Philanthropy Promotion Office, Civil Affairs Ministry, by 2009, China had about 9.4 million

disabled elderly, and more than 18.9 million "less disabled" elderly (*China Daily*, 2009).[11] Nearly 80% of the disabled elderly are living in rural areas. The second nationwide survey on people with disabilities estimated that the elderly (60+)[12] made up 75% of the additional 20 million individuals with disabilities in China from 1987 to 2007.[13]

The most recent statistics about disability among Chinese elders are from the 2010 Sample Survey on Aged Population in Urban/Rural China (SSAPUR). According to a press release about the most recent findings from SSAPUR (Zhang, 2011), there are 33 million (or 19%) adults age 60 and older who have an ADL disability, among whom 11 million (or 6%) are "completely" disabled.[14] It is estimated that by the end of 2015, there will be 40 million with any ADL disability, 12 million of whom will be completely disabled. More urban elders are severely disabled (needing help with 3 or more ADLs) than rural elders. By the end of 2010, among all of the completely disabled elders, a larger proportion of urban elders needed assistance with at least 3 ADLs (5% to 8% more than rural elders), while a larger proportion of rural elders (13% more than urban elders) needed assistance with 1 to 2 ADLs.

Data on long-term disability trends among Chinese older adults are scarce. Although the old-age disability trend among all major socioeconomic and demographic groups appears to have declined over the past two decades in Western countries, due to changes in the educational composition of the older population, increased wealth, increased use of assistive technologies,

[11] This is directly translated from the news report; no specific definitions of "disabled" and "less disabled" were given by the source.

[12] In China, people aged 60 and above are considered the "elderly" population.

[13] In this survey, the China Sample Survey on Disability (CSSD), people with disabilities are referred to as those who suffer from abnormalities of loss of a certain organ or function, psychologically or physiologically, or in anatomical structure and have lost wholly or in part the ability to perform an activity in the way considered normal (Liu, 2008). Five sub-classifications of disability, including "physical disability", were defined by CSSD.

[14] This is directly translated from the news report; no specific definitions of "disabled" and "less disabled" were given by the source.

and medical advances (Freedman, 2002 and 2008; Schoeni, 2005a and 2005b), this trend has not been seen in the developing world: the WHO (2002d) estimates that due to population aging and the increasing prevalence of chronic diseases, the LTC needs in many developing countries will increase by as much as 400% in the coming decades. Results of disability trends identified by limited studies in China are mixed (Gu, 2006; Ofstedal, 2007; Liu, 2008), largely due to different definitions of disability, short-trend periods examined, and different data sets used.

1.3.4 Current LTC situation in China: unsustainable care delivery and financing

Long-term care delivery and financing are the most important components of an LTC system, around which other components, such as measures of quality of care and the LTC workforce, build up. Although certain types of LTC services are being delivered through various organizations in different forms, currently there is no national LTC delivery and financing system in China.

1.3.4.1 Long-term care delivery

Certain types of LTC services are provided in institutions (e.g., nursing homes and elder care homes), in communities (e.g., community service centers and adult day care centers), or in homes (e.g., care provided by family members). Both formal and informal care exist, with the informal care provided by family members as the major source of LTC (Zeng, 2010; Wu, 2009; Jackson, 2004). The range of services exists and is continuously expanding in urban areas and the more developed provinces along the East Coast, while services have been limited in rural areas and the less developed inland provinces (Chu, 2008; Feng, 2011a).

Institutional care

Institutional LTC is provided through elder care institutions such as nursing homes, apartments specifically built for the elderly, and other social welfare institutions. Until recently, institutions were traditionally funded and operated by the government with small investments from some nongovernmental organizations and private investors. The number of such institutions is inadequate to meet the current LTC needs, and there is an imbalance or mismatch between care needs and provisions for care (Chu, 2008).

Realizing that it has very limited public resources to expand institutional care, the Chinese government has initiated policies to encourage private and foreign investment in building nursing homes and elder care homes, which has led to a rapid growth of elder care institutions in urban areas in recent years (Feng, 2011a). A majority of the new institutions are privately owned, located in cities, and draw most of their operating revenues from private-payers or other nongovernmental sources while at the same time receiving ongoing government subsidies. Since eligibility criteria for government-funded institutions do not apply to privately owned institutions, the key factor for admission into these institutions is the ability to pay, because the institutions are usually much more expensive than government-funded institutions. It is a common perception that these privately owned institutions serve primarily elders from high-income families.

Even with the recent growth of private nursing homes in urban areas, compared with the rapid growth of LTC needs, the expansion of institutional LTC has been slow. By the end of 2010, there were 39,904 elder care institutions with about 3.2 million beds (*China News*, 2011), or 26.5 beds per 1,000 older adults (in the U.S., the number is 44 beds per 1,000 older adults).[15] By

[15] This number was calculated by the author using the U.S. Census Bureau data: http://www.census.gov/compendia/statab/cats/health_nutrition.html

comparison, there are 11 million (or 6%) "completely disabled" elderly who may need institutional care (Zhang, 2011). Although there are some elders who will never go to nursing homes for various reasons no matter how disabled they are, this nearly 8-million gap in number of beds and number of completely disabled elderly Chinese is huge.

Despite the gap between LTC needs and provisions, currently only 2.4 million (or 2%) of older adults live in these institutions (*China News*, 2011), compared to the 5% to 8% reported by European countries and Hong Kong (OECD, 2011; Chu, 2006). On average, since the 1990s, the occupancy rate of LTC institutions nationwide has remained at 75%. On one hand, considering the growth of the elderly population and the increasing number of LTC institutions in recent years, this seemingly steady number reflects a growing absolute number of people being institutionalized. On the other hand, the 25% empty beds show a problem of "admission mismatch" in institutional care in China.

Government-funded institutions mainly serve older adults with poor financial resources (Wu, 2005; Fu, 2004; Tung, 2006) and usually have strict eligibility criteria for admission, which are called the "5-nil" criteria: no child, no regular income, living alone, widowed, or never married (Tung, 2006; Lee, 2004). Older adults with infectious diseases, mental illness (including dementia), and functional dependency usually are excluded if they are not "5-nil elders" (Wu, 2008). Therefore, older adults are institutionalized mostly for social reasons, such as low income, childlessness, or not having any relatives to live with (Zeng, 2010; Flaherty, 2007). Disabled older adults who need LTC may not meet the eligibility criteria; only 17% of institutionalized older adults have ADL limitations (Zhang, 2011).

The imbalance or mismatch between institutional care needs and provisions for care exists in two other areas too: resource mismatch and service mismatch.

(1) Resource mismatch. Although statistics show that nearly 80% of all institutions are located in rural areas, they are usually smaller (with fewer beds) and the quality of care varies across institutions (Zhang, 2011; Chu, 2008). Most large-scale and well-equipped nursing homes are in large cities. Resources are distributed unevenly between urban and rural institutions, with most care professionals and equipment in urban institutions (Zhang, 2011).

(2) Service mismatch. Elder care institutions provide general care and services for daily life, but very limited rehabilitation, mental, and spiritual care (Zhai, 2007).

Community-based care

Community-based care is provided through community service centers, residential care facilities, or adult day care centers, taking the forms of both formal and informal services. Common services provided include personal care, home maintenance, and referral services. In big cities, such as Shanghai, some centers also provide psychological or legal counseling services to older adults. Efforts to develop new models of community-based LTC for older adults in China have received growing attention, due to the skyrocketing public expenses in institutional care. The "Star Light Program" launched in 2000 is a major initiative to expand community-based services. Using a proportion of the social welfare lottery fund, more than 30,000 community welfare facilities for seniors, called the "Star Light Centers for Seniors," have been built between 2001 and 2004 (Chu, 2008). Although the services provided by these centers are broad with multiple functions, they do cover some LTC such as day care, social services, and recreational activities.

In addition to the formal services, there were 5.4 million volunteers providing informal caregiving services in communities (Zhang, 2003).

Just as the quantity of LTC provided in institutions is often inadequate, so too the quality of care provided varies between urban and rural areas and across institutions and community-based facilities (Zhang, 2011; Wu, 2008). Currently, there are no regulations on the professional care standards for nursing homes in China (Chu, 2008; Wu, 2008). Administrative personnel in government-run facilities are usually employed by the street committees (administrative units designated by municipal governments) or local civil affairs bureaus, a majority of whom have staff without specialized training in social work, nursing, or other relevant professional fields. Rural migrant workers constitute more than half of the frontline care workers in almost all forms of LTC facilities. The lack of LTC professionals in all types of institutions or facilities has been identified in institutional LTC and community-based LTC services in China (Wu, 2005).

Care in homes

Informal caregivers, usually female family members, provide LTC at home. This is widely expected to continue to be the predominant pattern of LTC in China (Zeng, 2010). Traditionally, Chinese elders have relied on family members to provide nearly all aspects of elder care and support. It is a legal requirement that children support their elderly parents (the People's Republic of China Aged Protection Act. Presidential Decree No. 73. Published on August 29, 1996). However, the tradition is under great stress and there are signs of erosion in the face of political, social, and economic changes, which are reducing the availability of informal care provided by family members. In particular, as mentioned before (see 1.3.1), the 4-2-1 family structure and gender imbalance have already been weakening and will continuously weaken the

informal support available to older adults. Other economic and social changes (e.g., higher female labor force participation) also may have a profound influence on the supply of informal caregivers, which is an essential part of the LTC system.

To cope with the increasing shortage of informal caregivers, along with the phenomenal domestic migration (National Bureau of Statistics of China, 2011; Huang, 2005), young female migrant workers from rural areas (known as *bao mu*, literally "housemaid") play an important role in providing various formal in-home services for urban older adults and their families. In recent years in China, fast economic development has lured a growing number of young people away from farms and into the cities in search of employment opportunities.[16] The migration population increased by more than 80% during the past decade, a large proportion of which were young people moving from rural areas to cities (National Bureau of Statistics of China, 2011). The number of *bao mu* in the labor market has increased dramatically (Wu, 2005). This trend has two direct effects on LTC among both urban and rural older adults: on one hand, the existence of *bao mu* in the cities increases the availability of caregivers to provide formal care to urban elders; on the other hand, these young women leave their elder parents/grandparents back at home in villages, without the traditional network of children to provide informal care to them.

1.3.4.2 Long-term care financing

Currently there is no publicly funded national health insurance program or LTC insurance program to cover LTC expenses for older adults in China (Feng, 2011a). Government-funded

[16] China has a strict household registration system (known as *Hukou* system which officially identifies a person as a rural or urban resident) to restrict domestic migration from rural areas to urban areas (Chan, 2010). In recent years, however, more young people have been moving from villages to cities despite the restrictions. They usually work in low-wage industries such as construction and food processing (Fan, 2004). Without an urban *Hukou*, they themselves and their children usually cannot obtain certain social welfares/benefits that their urban counterparts can (Qiu, 2011a and 2011b).

facilities are financed through general taxes (e.g., government-funded nursing homes) or the welfare lottery (e.g., the Star Light Program). Most older adults or their families pay LTC expenses out-of-pocket, through pensions, retirement salaries, remittances from adult children, or other private sources. China's average household savings rate is one of the highest in the world (Wang, 2010). It partly reflects the lack of social safety net in China. Expectations that the government will be the main source to provide elder care may be low (Feng, 2011b).

Very few private insurance plans cover LTC services, and they are usually unaffordable to medium and low-income families. Lack of financial sources for LTC services limits LTC demand, especially among rural older adults. The average annual income of farmers is less than one-third that of urbanites (Flaherty, 2007), which largely restricts their ability to pay for care they may need.

1.4 Challenges and Opportunities

Results from the recent national population census (2010) in China revealed a major challenge: population aging is accelerating. Together with the rapidly increasing prevalence of chronic diseases, LTC needs in China will increase in the coming decades, and LTC supplies may not be able to catch up with the fast-growing needs.

Although traditional informal family-based care is facing great challenges in both urban and rural areas, the problems arising with LTC in rural areas are more serious, due to less access to LTC services and the more rapidly declining availability of informal care provided by family members. Formal care systems are being developed slowly, and remain expensive.

In recent years, China has been undertaking national health care reforms (Wu, 2008; Yip, 2008), with a purpose to establish a basic health system to provide health services for all by the year

2020 (Hu, 2008). The household registration system (see footnote 16) is also under reforms, which will gradually allow rural residents to work and live "legally" in cities and expand rural migrant workers' access to public services and social welfare programs in cities. These movements are intended to close the gap between rural and urban areas and present a unique opportunity to examine the ability and sustainability of the current LTC situation to meet China's growing LTC needs. The question of how to develop a sustainable and feasible LTC system to fit country-specific conditions, as well as its cultural and traditional values, has become an important policy issue.

1.5 Descriptions of the Dissertation

1.5.1 Purpose and research questions

The purpose of this dissertation is to better understand different aspects of LTC issues in China by addressing the following three research questions:

1) What are the key risk factors for old-age disability in China?

2) What are the projected numbers of older adults with disabilities in China in future decades (through 2050)?

3) How might China develop a sustainable and feasible LTC delivery and financing system to address projected growth in LTC needs over the next four decades?

The urgent LTC policy issue in China is the fast-growing number of disabled older adults who may need LTC in the future, while there is no national LTC delivery and financing system in place to provide the needed services. To address this issue, policy makers should be informed about future LTC needs and provisions. In other words, who will need LTC (research question

1)? How many will need LTC (research question 2)? And how will China provide and finance LTC to meet LTC needs (research question 3)?

Compared to our knowledge about LTC issues in the developed world, our knowledge about current and future LTC situations in China is limited. Some of our knowledge about LTC from developed countries may transfer to China's context: for example, LTC needs are largely driven by population aging and chronic disease trends. Other country-/culture-specific factors, for example, domestic migration from rural to urban areas and larger rural/urban disparities in access to LTC services are also likely to affect overall LTC demand in China. The literature covering LTC issues in China is limited, with many studies adopting *qualitative* approaches, such as literature reviews and structured interviews. This dissertation is intended to expand our knowledge in the studied field through *quantitative* approaches combined with in-depth policy reviews and discussions.

1.5.2 Methodologies

Table 1.2 summarizes the research questions, methodological approaches, and data employed to answer each question. Details of methodological approaches are described in individual chapters.

Using the 2008/09 wave of Chinese Longitudinal Healthy Longevity Survey (CLHLS) data, I examine the relationship between key risk factors that have been identified in Western countries and disability amongst Chinese elderly. Using population projections, documentations and projections of trends in key risk factors, and disability data drawn from other sources, I employ a prevalence ratio approach to project the future numbers of frail older adults with disabilities through 2050. And finally, moving from analyses to policy implications, I address key policy issues related to LTC service supplies (e.g., delivery of services and financing) through a brief

review of common features of existing LTC models and international LTC policy guidelines. I then discuss this assessment in light of the results of the analyses on China-specific situations, and I provide some policy recommendations.

Table 1.2 Dissertation Structure: Research Questions, Methodological Approaches, and Data Sources

Research Questions	Methodological Approaches	Data Sources
1) What are the key risk factors for old-age disability in China?	Multinomial logistic regression; Logistic regression	Chinese Longitudinal Healthy Longevity Survey (CLHLS)
2) What are the projected numbers of older adults with disabilities in China in future decades (through 2050)?	Prevalence ratio projection modeling	Journal papers; projection data from U.S. Census and United Nations; Web search information; CLHLS
3) How might China develop a sustainable and feasible LTC delivery and financing system to address projected growth in LTC needs over the next four decades?	Literature reviews; Information synthesis	Journal papers; Web search information

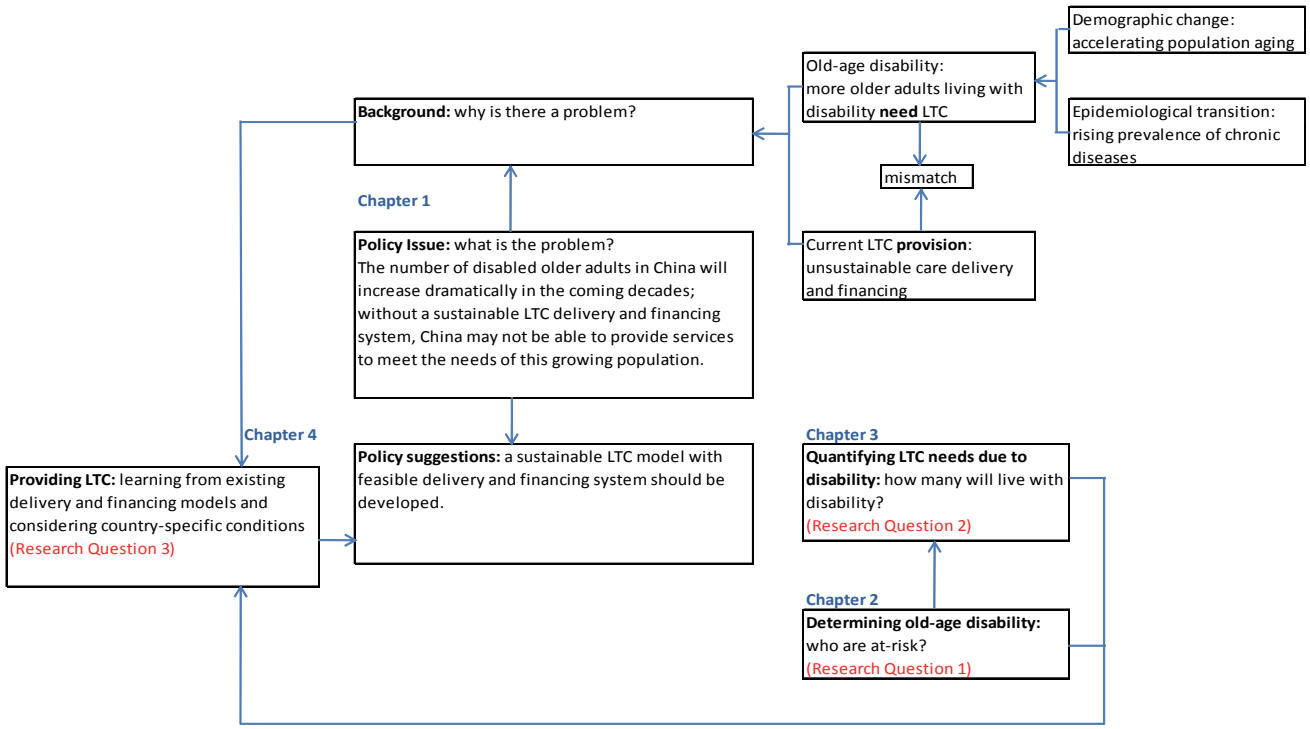
1.5.3 Roadmap

Figure 1.9 depicts the structure of the dissertation, illustrating the relationship between the policy issue and the three research questions, and briefly describes the contents of each chapter of the final dissertation.

The three research questions are closely related and should be answered in the following order (i.e., risk factors for old-age disability, projected numbers of older adults with disabilities, and LTC policy discussions), because the policy-making decisions need the information in a reverse order: to develop a LTC system to better address LTC needs in the future, policy makers must know the current and future size of the population of older adults with disabilities, who therefore, have potential LTC needs; to correctly project the population size of disabled elders (how many

may need care), one must identify risk factors associated with such disabling conditions (who may need care).

Figure 1.9 Dissertation Structure



Chapter 1 (the current chapter) introduces the policy issue and background (including drivers of LTC needs and current LTC provision in China), and briefly describes the structure of the dissertation. The remainder of the dissertation is organized as follows. Chapter 2 addresses the first research question: what are the key risk factors for old-age disability in China? Chapter 3 focuses on developing projections of older adults with disabilities in China in the next four decades (through 2050). Chapter 4 reviews common features of LTC systems worldwide and international LTC policy guidelines. Incorporating experiences from international practices, findings from empirical studies in previous chapters, and the China-specific context, this chapter answers the third research question: how might China develop a sustainable and feasible LTC

delivery and financing system to address its projected growth in LTC needs over the next four decades?

CHAPTER TWO Risk Factors for Old-Age Disability among Chinese

2.1 Key Risk Factors Identified in Previous Studies

The underlying factors of old-age disability are many and vary among individuals and across populations. Much of the research on old-age disability concludes that it is a physical condition, but one that is also socially constructed: it can be understood as a social condition representing the difference between environmental demand/expectations and individual's ability to meet such expectations (Lowry, 2010; Heikkinen, 2004; Verbrugge, 1994). Studies in the West have identified several key risk factors for old-age disability.[17] Some are nonmodifiable, such as age, gender, and genetics; others, such as chronic conditions, health behaviors (e.g., smoking, physical exercising), and social conditions (e.g., being unmarried and having low individual SES) can be modified. For the purpose of this study, all of the individual risk factors identified in the existing literature are grouped among the following five dimensions: demographics, health conditions and behaviors, community environment, social support, and SES.

Studies on risk factors for old-age disability in China have become popular in recent years, along with the growing number of elderly people and the increased awareness of health issues among the Chinese people. However, as is the case in many developing countries, data in China are limited.[18] The findings of existing studies are usually hard to generalize to the entire elderly population in the country, because of the studies' use of nonnationally representative data, or their focus on the general population, which includes very few older adults in the sample or uses

[17] The three main causes of disability are diseases, injuries, and the process of aging (Heikkinen, 2003). This dissertation focuses on old-age disability, which is caused mainly by aging and chronic diseases. Disability caused by injuries among older adults is outside the scope of this study.

[18] Major surveys include the China Health and Retirement Longitudinal Study (CHARLS pilot, 2008), the China Health and Nutrition Survey (CHNS, 1989, 1991, 1993, 1997, 2000, 2004, and 2006), the China Sample Survey on Disability (CSSD, 1987 and 2006), and the Sample Survey on the Aged Population in Urban/Rural China (SSAPUR, 2000, 2006, and 2010). However, data of CSSD and SSAPUR at the individual level are not publicly available.

disability measures not specifically adequate for older adults. Table 2.1 illustrates six studies on risk factors for old-age disability measured by ADL/IADL scales in China using different data sets. All studies except for Strauss (2010) use data collected more than 10 years ago, so they may not reflect current trends in disability.

Table 2.1 Summary of Selected Studies on Risk Factors for Old-Age Disability in China (SES not shown)

Author	Year	Setting	Sample Size	Disability Measure	Risk Factors		Data Source	Population
					Significant	Nonsignificant		
Strauss	2010	2 provinces	2,238	# of ADLs	age, Gansu province		CHARLS (2008)	45+
				# of IADLs	age			
Kaneda	2010	27 provinces	18,208	any ADL	age, marital status, engaging in social activities, residence	gender, smoking	SSAPUR (2000)	60+
Li	2009	22 provinces	9,093	any ADL	age, gender, residence, chronic conditions, ethnicity, living with family		CLHLS (1998, 2000)	80+
Zeng	2007	22 provinces	13,294	any ADL	age, residence, ethnicity		CLHLS (1998, 2000)	80+
Zimmer	2004	12 provinces	20,083	any ADL	age, gender	marital status	SSAPUR (1992)	60+
Liang	2001	1 province	2,322	any ADL	age, marital status, residence, self-rated health	gender, smoking, chronic conditions	Wuhan Survey (1991, 1994)	60+

The findings from previous studies are summarized under the headings of the individual groups that follow.

Demographics (age, gender, ethnicity)

Demographic factors include age, gender, and ethnicity. Age has been found to be the most important risk factor for old-age disability. Advanced aging causes changes in bodily structures and functions and appears to be a strong and consistent predictor of functional disability (Verbrugge, 1994; Finkel, 1995; Miller, 2000). Gender differences in old-age disability are

substantial. In general, age-related changes in the endocrinologic system vary for men and women (Viidik, 2002). Men's lives are shorter due to fatal diseases and women survive longer but have more chronic conditions (Verbrugge, 1985). Jagger (2007) finds that older women in the UK are less likely to be disability-free than older men. Similar conclusions are reached in the U.S. and Canada (Chappell, 2008), Spain (Sagardui-Villamor, 2005), the Netherlands (der Wiel, 2001), and Sweden (Socialstyrelsen, 2001).

The association between ethnicity and disability has been studied in both developed and developing countries. Disadvantaged minority groups (i.e., in terms of SES, access to health care, health awareness and knowledge, etc.) are generally found to have a higher risk for disability. For example, in the U.S., blacks are reported to have a greater risk for disability than whites (He, 2005; Steinmetz, 2006); in Malaysia, disabilities increase among men who are non-Malay (Siop, 2007).

Studies in China have examined these demographic factors too. Similar to Western countries, age has been found to be the most important risk factor for disability in China, and this finding is consistent across studies and across all age groups (Strauss, 2010; Kaneda, 2010; Li, 2009; Zeng, 2007; Zimmer, 2004; Liang, 2001). Women are more likely to report ADL disability than men (Li, 2009; He, 2007; Zimmer, 2004). This gender difference may be more apparent in China because of some nation-specific situations. For example, bound-foot deformities among Chinese old women, especially among the oldest old, are still common (Cummings, 1997). These women are more likely to fall, or they may find it more difficult to perform some daily activities, such as rising from a chair without assistance (Liang, 2001). Ethnicity is another special factor in the Chinese context. As described previously (see footnote 9 in Chapter 1), there are 56 ethnic groups in China, although just one, Han, accounts for over 90% of the population. Most ethnic

minority groups live inland or in rural areas, are less educated, and their access to health care and LTC is limited (Hannum, 2011). However, using 1998 and 2000 waves of CLHLS data, Zeng (2007) and Li (2009) both conclude that the Han people are more likely than minority groups to have ADL limitations. The authors do not provide explanations for this seemingly unusual finding.

Health conditions and behaviors (chronic disease, self-rated health, smoking, exercising)

Chronic diseases, such as stroke, hypertension, diabetes, and arthritis, are linked to functional decline and disability (Goldberg, 1997; Wagner, 1997; Miller, 2000; Visscher, 2001; Infeld, 2002). Some chronic diseases create generalized body impairment(s) and particularly affect older adults' lower-body functions. For example, stroke and arthritis may cause decreased muscle strength and impaired balance, which can lead to mobility limitations, such as impaired ability to walk, which can make shopping difficult (Heikkinen, 2004). Poor self-rated health is also found to be associated with functional impairment (Miller, 2000; Siop, 2007).

Certain health behaviors contribute to the development of disability in old age, among which participation in physical activities and smoking history have been examined widely. Smoking is associated with increased risk of heart disease, stroke, chronic lung disease, and several types of cancer (Keil, 1998); it also has an effect on physiological function independent of diseases (Heikkinen, 2004). Regular physical exercise, on the other hand, can help to maintain healthy weight and cardiovascular health and reduce the likelihood of many chronic diseases, such as diabetes and heart disease (U.S. Department of Health and Human Services, 2008). A systematic review (Stuck, 1999) finds that both low levels of physical activity and smoking increase the risk for functional status decline.

Similar conclusions have been reached with regard to chronic diseases (Li, 2009) and self-rated health (Liang, 2001) in China. Two studies (Kaneda, 2010; Liang, 2001) find no significant association between smoking and disability; one study (Wong, 2001) finds that regular leisure time activities, including coordination and balance exercises, such as Tai Chi, reduce the risk of chronic ADL limitations and falls.

Community environment (Community SES)

Community environment or community SES has been considered a predictor of health outcomes, including functionality (Glass, 2003; Pickett, 2001; Schootman, 2006). The characteristics of the community in which elders live may influence their health through various mechanisms, such as accessibility to health services and professionals, health awareness, infrastructure, communication and education, and factors that are indirectly related to individual SES, such as community income (Zimmer, 2010). Overall findings concerning the community environment have been mixed (Zimmer, 2010).

In China, urban and rural residency has been examined as a measure of the community environment factor, with mixed results. Kaneda (2010) and Liang (2001) conclude that rural elders are more likely to have ADL disabilities, given that rural residents usually have less access to health care, less education, and lower income than urban residents. Using different waves of CLHLS, Li (2009) and Zeng (2007) reach the opposite conclusion: they find that the urban oldest old have a higher ADL rate than their rural counterparts. Factors that lead to this urban disadvantage may include poorer air quality in cities (therefore causing more chronic respiratory diseases) (Zeng, 2010), and the fact that Chinese rural elders exercise more by performing outdoor activities and doing physical work in farming activities (Clarke, 2005). In addition to

urban or rural residency, other community SES measures have been investigated. For example, Kaneda and colleagues (2010) use community revenue per capita and the percentage of homes with modern utilities as community SES measures; they do not find significant relationship between the two community SES measures and disability.

Social support (marital status)

Both the quantity and quality of social support significantly affect the development of old-age disability (Mendes de Leon, 1999; Everard, 2000; Koukouli, 2002). A low frequency of social contact has been associated with poor or worse physical functioning (Stuck, 1999), because people with strong social relations are more likely to recover from serious illness and to survive than those with weak social relationships (Berkman, 2000). As a measure of social support, marital status has been found to be another important factor associated with disability in Western countries, with the odds of disability higher for those who are unmarried (Schoeni, 2001, 2005b; Langa, 2008). Except for marital status, existing studies also suggest some other measures of social support, such as living with family members (Beydoun, 2005) and participating in social activities (James, 2011). These measures, however, in contrast to marital status, are susceptible to endogeneity bias: older adults with one or more disabilities may choose to live with other family members because it is more convenient for family members to provide care, and older adults with a disability may be less able to engage in an active social life. Hence, I do not include such measures in my model.

In China, it has been found that married older adults are less likely to report functional limitations (Kaneda, 2010; Liang, 2001).

SES (education, income, occupation, other SES measures)

SES is the combined measure of an individual's position in society, which is usually based on one's education, income/wealth, and occupation. Examining the relationship between SES and disability status is important: for example, if lower SES affects disability, then policies that target the disadvantaged populations and enhance their socioeconomic well being (e.g., improving their education) may have long-lasting benefits that extend into old age.

The connections between SES and health outcomes including disability have been widely documented in developed countries (Melzer, 2000; Adams, 2003; Marmot, 1999&1995; Smith, 2005; Grundy, 2000). The prevalence of old-age disability is generally lower among older adults from relatively privileged SES groups (i.e., higher income/wealth, better education). The causal direction and mechanisms of the association, however, have been difficult to pinpoint, and recent studies have concentrated on identifying the causal effects and uncovering the underlying mechanisms that produce the causal relationships. Explanations may involve psychosocial advantages among those with high SES, including material pathways (e.g., older adults with higher income can afford more health resources) and nonmaterial pathways (e.g., older adults with higher education may have a better understanding of disease processes and may, as a result have more success with self-treating illness; they also tend to have more social support and stronger networks) (Zimmer, 2010; House, 1992; Marmot, 2004).

In China, the relationship between old-age disability and SES has not been well studied, which hinders the researcher's ability to compare the findings of Chinese and Western literature on that topic. Additionally, older adults in China, especially the oldest old, usually have significantly lower levels of education and income, compared to their counterparts in the West (Liang, 2001). It would be interesting to see if the same association between SES and disability observed in the West can be found among the very different Chinese population. China's current older adult

population grew up in a more homogeneous society than their Western counterparts. There is little individual variation in terms of SES. Most individuals have very little or no education (for instance, the literacy rate is only 11% among rural elderly women) (Liang, 2000). Many of these elders worked as agricultural workers in rural areas when they were young. Income distribution among them is relatively egalitarian (Liang, 2001). And, finally, the political system that the elderly population grew up with allowed for egalitarian access to health care, which might moderate the association between SES and general overall health (Zimmer, 2004).

The existing studies in China use both traditional (e.g., education, household income) and nontraditional SES indicators (household consumption, health insurance, cadre status, home ownership, household possessions/assets, pensions, bank savings, and residence, to name just a few) . Table 2.2 summarizes findings from selected studies on SES and disability in China: overall SES and old-age disability do not seem to show strong associations. Most of the studies fail to document significant associations between SES and disability; but whenever such a significant relationship exists, it is negative: higher SES is related to lower disability risks. All seven studies cited in Table 2.2 examine the relationship between education and ADL limitation, although the ways they measure education are not exactly the same. Only one study (Liang, 2001) shows a significant negative association based on data from one province. Two studies (Zimmer, 2004; Kaneda, 2010) investigate the relationship between savings and ADL limitation using nationally representative data; both document a significant negative association. The relationships between childhood SES and ADL limitation and between pension and ADL

limitation are examined by Zeng (2007) and Zimmer (2004), respectively; both show negative associations that are significant only conditionally.[19]

Table 2.2 Summary of Selected Studies on SES and Old-Age Disability in China

SES Indicators	Measures	ADL	IADL	Source
Education	Illiterate, can read or write, primary, junior high +	n/s	negative	Strauss, 2010
	Having at least primary school education	n/s	n/a	Kaneda, 2010
	Years of formal schooling	n/s	n/a	Li, 2009
	Having at least one year's schooling	n/s	n/a	Zeng, 2007
	Illiterate, primary, intermediate or more	n/s	negative	Beydoun, 2005
	Years of formal education	n/s	n/a	Zimmer, 2004
	Total number of years in school	negative	n/a	Liang, 2001
Savings	Having enough savings	negative	n/a	Kaneda, 2010
	Having bank savings	negative	n/a	Zimmer, 2004
Occupation	High occupational status (professional/technical personnel, administrative/managerial positions)	n/s	n/a	Li, 2009
Household utilities	Living in a house with modern utilities (e.g., water, gas, heating and toilet)	n/s	n/a	Kaneda, 2010
Assets	A household amenities score: 0-6.	n/s	n/a	Zimmer, 2004
Household income	Per capita household income	n/s	n/s	Beydoun, 2005
Income	Log of total household income	n/s	n/a	Zimmer, 2004
Household consumption	Log of per capita expenditure	n/s	negative	Strauss, 2010
Community SES	Community revenue per capita, % of houses with modern utilities	n/s	n/a	Kaneda, 2010
Childhood SES	Received adequate medical service, frequently went to bed hungry, father's occupation was high level, born in urban area	negative*	n/a	Zeng, 2007
Pension	Being eligible for a pension	negative**	n/a	Zimmer, 2004

Notes:

n/s - Nonsignificant relationship
n/a - Not applicable since the study did not examine IADLs
negative - Significant negative relationship
* Among all the childhood SES measures, only "received adequate medical service" is significant.
** Only significant among urban residents

[19] In Zeng (2007), among all the childhood SES indicators, only "received adequate medical services" is significant; in Zimmer (2004), pension has a significant negative association with ADL limitation among urban residents only.

All other SES indicators are found to be nonsignificantly related to ADL limitation.[20] Limitations with instrumental activities of daily living have been less commonly studied; however, Strauss (2010) and Beydoun (2005) report a statistically significant negative relationship between education and IADL limitation.[21]

2.2 Methodological Approach

2.2.1 Data

The most recent wave (2008/09) of the CLHLS is used to examine the key risk factors for old-age disability in China. I use these data because: (1) they are nationally representative; (2) the quality of the data is good; (3) the data are new (released in September 2011); they have not been widely studied; (4) they focus on a large sample size of the oldest old (n = 11,659), which provides a critical age cohort for understanding disability trends; and (5) the survey collects full sets of ADLs and IADLs data.

The 2008/09 survey contains 16,540 respondents.[22] It covers 22 of the 31 provinces in mainland China (85% of the total population), and focuses on the oldest old; it also includes "young" elders (aged 65 to 79) as a comparison. The survey collects data on demographic background, living arrangement, health outcomes, physiological indicators, lifestyle, sibling information, children and fertility history, care needs/costs, and end of life care. The total sample size in

[20] These SES indicators include household consumption (examined by one study), household utilities (one study), community SES (one study), occupation (one study), household income (two studies), and assets (one study).

[21] Strauss (2010) defines the IADL outcome as "total number of IADLs", while Beydoun (2005) uses the "IADL only" measure.

[22] The response rate for the 2008/09 survey was not reported in the technical report. But the 2005 document reported that nonresponse rate among the oldest old was very low, about 4% in previous waves (Gu, 2007).

2008/09, excluding adults younger than 65 and older than 106 (because of concerns about age misreporting or misrepresentation),[23] is 15,856.

2.2.2 Measures

Outcome variables

Respondents were asked about difficulty with ADLs (bathing, dressing, using the toilet, indoor mobility, eating, and continence) and IADLs (visiting others in the neighborhood, shopping, cooking, washing clothes, and using public transportations). A respondent who reported needing any level of assistance with one or more of six ADLs was considered to have an ADL limitation.[24] A respondent who reported "having a little difficulty with" or "being unable to do" one or more of five IADLs was considered to have an IADL limitation.

Two disability outcome variables are defined: (1) a categorical variable "disability status" with three alternatives, nondisabled (reference group), IADL limitation only, and any ADL limitation, and (2) a dummy variable "any 3+ ADLs" limitation, which is coded 1 if the respondent has 3 or more ADLs; otherwise it is coded 0. The categorical outcome captures three individual disability statuses consistent with prior literature (Freedman, 2008; Schoeni, 2008; Berger, 2008), and the dummy outcome distinguishes the severely disabled from everyone else (Zhang, 2011; Stallard, 1999). Investigating different disability statuses has important policy implications:

[23] Significant misreporting of age in China has been found among minority groups and those above 105 (Coale, 1991; Wang, 1998). Therefore the CLHLS excludes nine provinces with the highest density of minority populations. Excluding elders age 105 and above is important, since misreporting of age bedevils demographic analyses of the very old in most developing countries as well as in the U.S. and some other developed countries (Coale, 1986; Preston, 1996; Elo, 1994; Preston, 1998; Kannisto, 1990).

[24] For example, a respondent who reported that he/she could "feed self, with some help" and a respondent who reported that he/she "receives assistance in feeding or is fed partly or completely intravenously" were both considered to have a disability with eating. Similarly, a respondent who reported that he/she "receives assistance in bathing only for part of the body (such as back or a leg)" and a respondent who reported that he/she "receives assistance in bathing more than one part of the body" were both considered to have a disability with bathing.

although older adults with any ADL or with an IADL only limitation are the disabled population that may need LTC; those who have IADL only limitations are generally considered mildly disabled, and most of them may use informal care provided by family members on an ongoing basis. Older adults with 3+ ADLs limitation are considered to have very severe LTC disabilities, and for that reason their need for care may be much more difficult to meet with informal care or they may require formal, institutional care (Stallard, 1999).

Risk factors

I examine risk factors under five dimensions: demographics (age, gender, ethnicity); health conditions and behaviors (proxy response, chronic disease, self-rated health, smoked in the past, exercised in the past); community environment (province, residence, availability of social services); social support (marital status); and SES (respondent's father's education and occupation, whether or not respondent received adequate medical service in childhood, whether or not respondent frequently went to bed hungry in childhood, respondent's own education, house ownership, self-rated economic status, and household income).

In the past, a few measurements of risk factors have not been widely examined in the China context, including 1) proxy response, 2) province, and 3) some nontraditional SES indicators. I include these factors in this dissertation.

The variable of "proxy response" is an indicator of the extent to which the respondent relied on a proxy to complete the survey's ADL/IADL questions, i.e., the number of ADL/IADL questions answered by a proxy instead of the respondent. Studies have documented disagreement between proxy and respondent reports, and the level of agreement is influenced by a few factors such as education, age, and living arrangement (Rothman, 1991; Tang, 2002; Zsembik, 1994).

Magaziner (1997) shows that proxies tend to report more disability than respondent. To adjust for such a bias, researchers usually add a proxy variable. In the CLHLS, ADL and IADL questions are answered by the interviewees themselves as much as possible. For those who are "unable to answer", a close family member or another acknowledgeable proxy (e.g., significant other) provides answers (Gu, 2007). It is unknown whether the fact that proxies answered the questions instead of the older adults themselves indicates cognitive impairment among those respondents. I control for the proxy status but I also compare the results with and without this control.

Province, as a community environment measure, is investigated, given that disparities (in terms of economic development, health care infrastructure, individual and community SES) exist across provinces. Guangxi province is selected as the reference group because it has the largest number of respondents. It locates in the southwest of the country and is an inland underdeveloped province with large percentages of minority populations.

In addition to traditional SES (respondent's own education, household income), I consider several "nontraditional" SES measures suggested by the literature in China and according to my understanding of the national context. Following Zeng's methodology (2007), I include data on the adequacy of respondents' medical care as children and whether respondents frequently went to bed hungry in childhood; following Lowry (2009), I include house ownership. I also consider several measures that are unique in my data but have not been researched by other studies in China, including self-rated economic status, and respondents' fathers' education and occupation. These SES indicators are further grouped under childhood SES and adulthood SES, following Freedman (2008) and Zeng (2008). Table 2.3 describes each variable.

Table 2.3 Descriptions of Variables in Risk Factor Analysis

Variable	Type	Descriptions	Note/Questionnaire
Outcome Variable			
Disability status	categorical	1 = nondisabled, 2 = IADL only, 3 = any ADL	Ref: nondisabled
Any 3+ ADLs	binary	1 = any 3+ ADLs, 0 = other	
Risk Factor			
Demographics			
Age	continuous	65 - 105	
Gender	binary	1 = male, 0 = female	
Ethnicity	binary	1 = Han, 0 = other	
Health conditions and behaviors			
Proxy response	ordinal	0 - 11	indicates the total number of ADL/IADL questions being answered by a proxy
Chronic diseases	binary	1 = yes, 0 = no	"Are you suffering from any of the following diseases: hypertension, diabetes, heart disease, stroke, CVD, bronchitis, emphysema, asthma, pneumonia, cancer, Parkinson's disease, arthritis, and dementia?"
Self-rated health	ordinal	1 = very good, 2 = good, 3 = so so, 4 = poor, 5 = very poor	
Smoked in the past	binary	1 = yes, 0 = no	"Did you smoke in the past?"
Exercised in the past	binary	1 = yes, 0 = no	"Did you exercise in the past?"
Community Environment			
Province	categorical	22 provinces	Ref: Guangxi
Residence	categorical	city, town, rural	Ref: rural
Social services in community	binary	1 = yes, 0 = no	"Is there any social service program (personal care services, home visits, psychological consulting, daily shopping, social and recreation activities, human rights consulting services, health education, neighboring relations, and other services) available in your community?"
Social support			
Marital status		1 = currently married, 0 = other	"Other" status include: separated, divorced, widowed, and never married
Socioeconomic status (SES)			
Childhood SES			
Father's schooling	binary	1 = ≥ 1 year, 0 = no schooling	
Father's occupation	binary	1 = Agricultural worker, 0 = other	"What was your father's occupation when you were a child?"
Adequate medical services	categorical	1 = yes, 2 = no, 3 = not sick	Ref: yes "Could you get adequate medical service when you were sick in childhood?"
Went to bed hungry	binary	1 = yes, 0 = no	"Did you frequently go to bed hungry as a child?"
Adulthood SES			
Own schooling	continuous	0 - 25	
House ownership	binary	1 = purchased/self-built/inherited, 0 = other	"Is your house/apartment purchased/self-built/inherited/rented?"
Self-rated economic status	ordinal	1 = very poor, 2 = poor, 3 = so so, 4 = rich, 5 = very rich	"How do you rate your economic status compared with others in your local area?"

2.2.3 Statistical approaches

Following convention in the literature (Freedman, 2008; Schoeni, 2008; Berger, 2008), I treat the "disability status" measure as an unordered categorical variable, with three alternatives: nondisabled (reference group), IADL only limitation, and any ADL limitation.[25] I use multinomial logistic regression to model the prevalence of limitations (nondisabled, IADL only, and any ADL) as a function of risk factors and use a logistic regression to model the dichotomous outcomes ("any 3+ ADLs" limitation). Sampling weights are used for all analyses.

I first examine the bivariate associations between individual risk factors and disability outcomes. Risk factors associated at $p < .20$ in either model are retained in both final multivariate models. To examine the associations with and without province effects, two multivariate models are defined:

- *Model 1:* all risk factors including two community environment variables (residence and availability of social services in the community) but excluding province. This is the conventional model that previous studies in China adopt (Liang, 2001; Zeng, 2007; Li, 2009; Kaneda, 2010).
- *Model 2:* model 1 + province controlled.

2.3 Results

2.3.1. Descriptive statistics

[25] Instead of ordered logistic regressions, multinomial logistic regressions are used for the "disability status" outcome as suggested by the literature, and considering the fact that the order of the three alternatives (nondisabled, IADL only, and any ADL) is not conceptually clear. These two approaches yield substantially similar results (data not shown).

Descriptive statistics are shown in Table 2.4.[26]

Table 2.4 Descriptive Statistics of 2008/09 CLHLS (N=15,856)

Variable	Mean (SD) or %	Median	Min	Max
Outcome Variable				
Disability status				
Nondisabled	37.0%			
IADL only *	40.5%	2	1	5
Any ADL *	22.5%	2	1	6
Any 3+ ADLs	11.1%			
Risk Factor				
Demographics				
Age	86.8 (0.09)	88	65	105
65 - 69	8.6%			
70 - 74	9.4%			
75 - 79	8.5%			
80 - 84	12.1%			
85 - 89	14.2%			
90 - 94	18.9%			
95 - 99	9.5%			
100 - 105	18.8%			
Gender: male	34.8%			
Ethnicity: Han	94.0%			
Health Conditions and Behaviors				
Proxy response (total number)	3.1	0	0	11
Chronic diseases:				
Yes	49.3%			
No	48.5%			
Missing	2.2%			
Self-rated health (1-5, 1=very good)	2.6 (0.01)	3	1	5
Smoked in the past	27.9%			
Exercised in the past	29.6%			
Community Environment				
Province				
Beijing	2.1%			
Tianjin	0.8%			
Hebei	1.0%			
Shanxi	1.0%			
Liaoning	4.0%			
Jilin	2.2%			
Heilongjiang	2.1%			
Shanghai	3.5%			
Jiangsu	8.5%			
Zhejiang	6.7%			

[26] For four risk factors (respondents' fathers' schooling, adequate medical services for illness in childhood, frequency of going to bed hungry as children, and per capita household income) that have more than 2% missing cases, a "missing" category was created.

Anhui	4.5%			
Fujian	2.1%			
Jiangxi	1.7%			
Shandong	11.4%			
Henan	6.8%			
Hubei	4.2%			
Hunan	5.3%			
Guangdong	5.9%			
Guangxi	12.1%			
Chongqin	3.9%			
Sichuan	9.1%			
Shannxi	1.1%			
Residence				
Rural	52.8%			
City	24.0%			
Town	23.2%			
Any social services in community	28.4%			
Social Support				
Currently married	28.8%			
Socioeconomic Status (SES)				
Father's schooling				
No schooling	79.3%			
Some schooling	17.5%			
Missing	3.2%			
Father's occupation when Respondent was Child				
Agricultural worker	82.6%			
Other	17.4%			
Adequate medical service in childhood				
Yes	31.8%			
No	59.1%			
Missing	9.1%			
Frequently went to bed hungry				
Yes	70.4%			
No	25.2%			
Missing	4.4%			
Own schooling (yrs)	1.9 (0.03)	0	0	25
House ownership	88.4%			
Self-rated economic status (1-5, 1=very poor)	3.0 (0.01)	3	1	5

Note: * The median, minimum, and maximum of "IADL only" and "any ADL" represent the IADL and ADL counts, among those who have IADL only and any ADL.

About one-third (34.8%) respondents are male, and the majority (94%) are Han. Two-thirds (67.3%) do not need a proxy to help with answering any ADL/IADL questions, but 23.8% need a proxy to help with answering all eleven ADL/IADL questions. Around half (49.3%) have at least one chronic condition, and one-fifth (19.6%) report poor or very poor health. Less than

one-third of respondents (27.9%) smoked in the past, and 29.6% used to exercise in the past. More than half (52.8%) live in rural areas, while the rest of the respondent population is evenly distributed in cities (24%) and towns (23.2%). Nearly 30% report that social services are available in the community. Less than one-third (28.8%) are currently married.

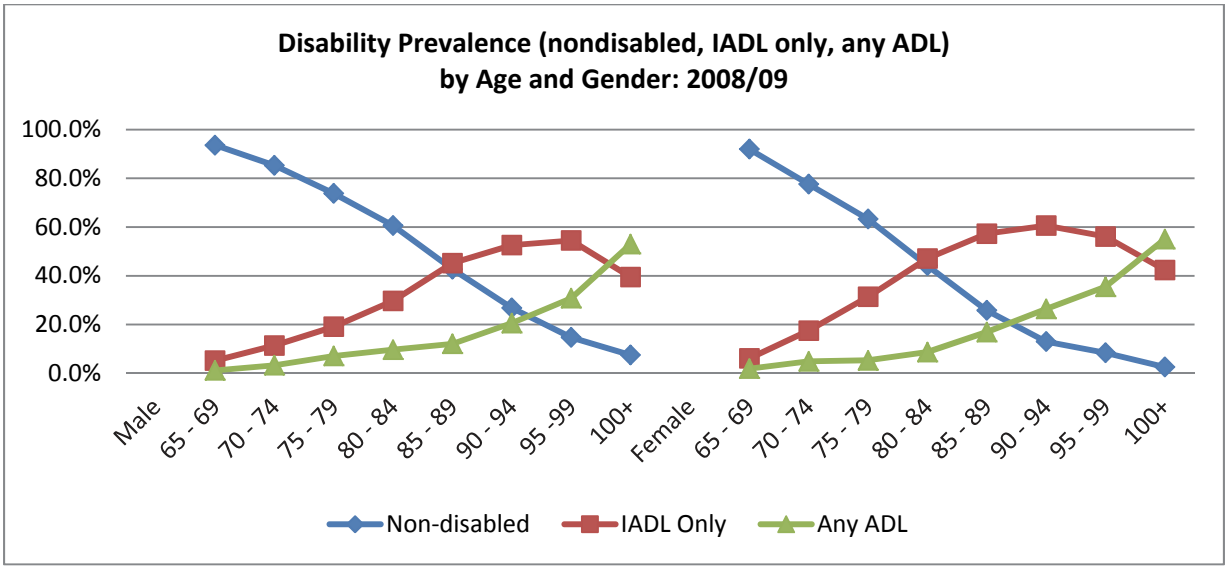
More than three-quarters (79.3%) of respondents report that their fathers had no schooling and 82.6% report that their fathers were agricultural workers. During childhood, more than half (59.1%) say they did not receive adequate medical services when they were sick and 70.4% report that they frequently went to bed hungry. The mean number of years of respondents' own schooling is two, with nearly two-thirds (64.7%) reporting zero years of education. The house ownership rate is high (88.4%).

Thirty-seven percent of respondents do not report any ADL or IADL (i.e., nondisabled), 40.5% report IADL limitation only, and the rest (22.5%) have at least one ADL limitation. Among all the respondents, 11.1% have 3+ ADLs limitation.

2.3.2. Bivariate analysis

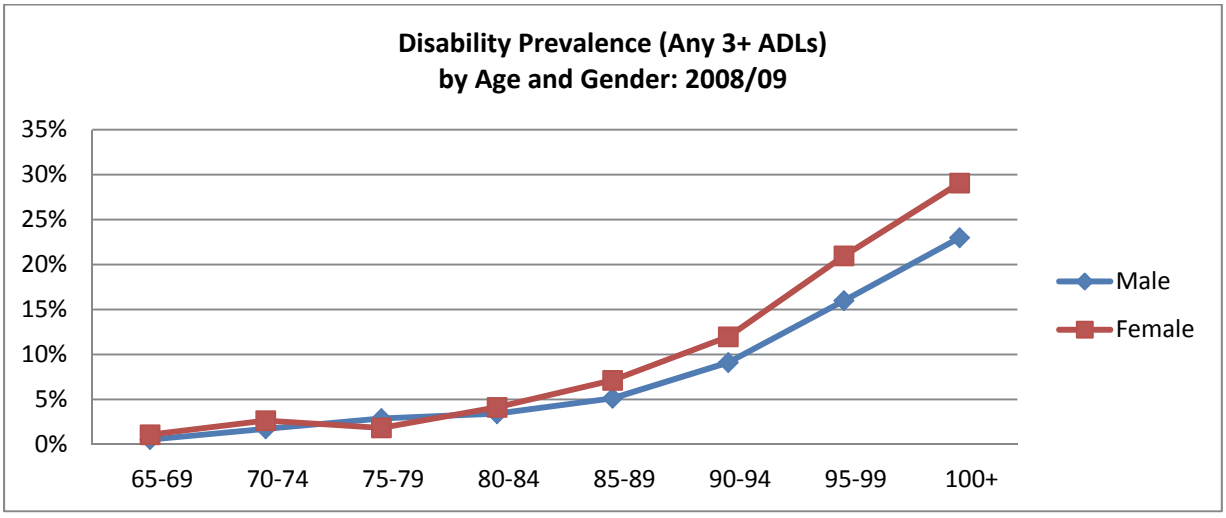
Figures 2.1 and 2.2 show the distributions of disability by age group and gender. Consistent with previous literature, disability increases with age and risks are higher among women.

Figure 2.1 Disability Status (Nondisabled, IADL Only, Any ADL) by Age Group and Gender: 2008/09



Data source: CLHLS 2008/09

Figure 2.2 Disability Status (Any 3+ ADLs) by Age Group and Gender: 2008/09



Data source: CLHLS 2008/09

Bivariate results for both "disability status" and "any 3+ ADLs" outcomes are shown in Table 2.5.

Table 2.5 Bivariate Associations of Risk Factors and Disability, 65+ Population, 2008/09 (Relative-Risk Ratios and Odds Ratios reported; N=15,856)

Risk Factor	Difficulties with ADL and with only IADL (vs. nondisabled)				Difficulties with any 3+ ADLs	
	IADL only (RRR)	p	Any ADL (RRR)	p	OR	p
Demographics						
Age	1.16	0.000	1.24	0.000	1.11	0.000
Age_squared	0.99	0.000	1.00	0.000	1.00	0.000
Gender: male	0.36	0.000	0.30	0.000	0.46	0.000
Ethnicity: Han	0.85	0.038	1.56	0.000	1.66	0.000
Health Conditions and Behaviors						
Proxy response	1.23	0.000	1.43	0.000	1.25	0.000
Chronic diseases: (vs. no)						
Yes	1.03	0.475	1.31	0.000	1.62	0.000
Missing	1.12	0.374	1.06	0.713	1.34	0.134
Self-rated health (1-5, 1=very good)	1.33	0.000	2.04	0.000	2.52	0.000
Smoked in the past	0.50	0.000	0.43	0.000	0.56	0.000
Exercised in the past	0.70	0.000	0.88	0.011	0.87	0.018
Community Environment						
Residence: (vs. rural)						
City	0.66	0.000	1.61	0.000	1.54	0.000
Town	0.82	0.000	0.87	0.019	1.01	0.945
Any social services in community	0.89	0.007	1.12	0.023	1.07	0.228
Social Support						
Currently married	0.20	0.000	0.11	0.000	0.24	0.000
Socioeconomic Status (SES)						
Father's schooling: (vs. no schooling)						
Some schooling	0.57	0.000	0.57	0.000	0.71	0.000
Missing	0.99	0.951	1.55	0.000	1.65	0.000
Father's occupation when Respondent was a child: agricultural	1.40	0.000	1.14	0.032	1.01	0.917
Adequate medical service in childhood (vs. yes)						
No	1.45	0.000	1.43	0.000	1.20	0.004
Missing	1.86	0.000	2.02	0.000	1.56	0.000
Frequently went to bed hungry (vs. no)						
Yes	1.46	0.000	1.26	0.000	1.13	0.074
Missing	1.91	0.000	2.67	0.000	2.07	0.000
Own schooling (yrs)	0.84	0.000	0.84	0.000	0.89	0.000
House ownership	1.18	0.012	0.78	0.000	0.74	0.000
Self-rated economic status (1-5, 1=very poor)	0.76	0.000	0.78	0.000	0.79	0.000

Note: Bivariate results between province and disability status are not reported due to space limitations.

In the "disability status" model, higher risks for developing both ADL and IADL only limitations are associated with more proxies, older age, being female, unmarried, and poorer self-rated health status. Exercising history is significantly related to lower disability risks, and surprisingly, so is smoking history. Respondents with at least one chronic condition are more likely to report any ADL limitation.

All SES measures are significantly related to disability ($p < .05$ for all), and respondents with higher SES seem less likely to have any ADL and IADL only limitations: higher education (both respondents' fathers and respondents themselves), respondents' fathers having had nonagricultural jobs, respondents having received adequate medical services, not frequently going to bed hungry in childhood, and higher self-rated economic status are all indicative of lower ADL and IADL disabilities.

Associations between the following risk factors and the two disability statuses, any ADL and IADL only limitations, take different directions: Han people, and those living in cities or living in communities with social services are more likely to have at least one ADL limitation but less likely to have an IADL only limitation; owning (rather than renting) the house increases the IADL only risk but decreases any ADL risk.

Results of "any 3+ ADLs" limitation are largely consistent with those of "any ADL" limitation.

2.3.3. Multivariate analysis

Results of multivariate analysis are shown in Table 2.6 for "disability status" outcome and Table 2.7 for "any 3+ ADLs" limitation outcome.

Table 2.6 Multivariate Associations of Risk Factors and "Disability Status", 65+ Population, 2008/09 (Relative-Risk Ratios reported; N = 15,770)

Risk Factors	Difficulties with ADL and with IADL only (vs. nondisabled)							
	Model 1				Model 2 (Model 1+province)			
	IADL only (RRR)	p	any ADL (RRR)	p	IADL only (RRR)	p	any ADL (RRR)	p
Demographics								
Age	1.14	***	1.19	***	1.15	***	1.21	***
Age_squared	0.99	***	1.00	**	0.99	***	1.00	*
Gender: male	0.59	***	0.59	***	0.61	***	0.57	***
Ethnicity: Han	1.00		1.58	**	0.87		1.01	
Health Conditions and Behaviors								
Proxy response	1.10	***	1.24	***	1.10	***	1.24	***
Chronic diseases: (vs. no)								
Yes	1.51	***	1.84	***	1.51	***	1.98	***
Missing	1.23		1.36		1.34	#	1.70	*
Self-rated health (1-5, 1=very good)	1.49	***	2.54	***	1.58	***	2.91	***
Smoked in the past	1.01		1.01		0.96		0.93	
Exercised in the past	0.88	*	0.98		0.85	**	0.88	
Community Environment								
Residence: (vs. rural)								
City	0.85	*	2.18	***	0.76	**	1.36	**
Town	0.84	**	0.97		0.98		1.14	
Any social services in community	1.05		1.22	**	1.08		1.39	***
Social Support								
Currently married	0.88	*	0.77	**	0.85	**	0.72	***
Socioeconomic Status (SES)								
Father's schooling: (vs. no schooling)								
Some schooling	0.91		0.91		0.90		0.97	
Missing	0.93		1.08		0.82		0.96	
Father's occupation when Respondent was a child: agricultural	0.89		0.90		0.92		0.85	
Adequate medical service in childhood (vs. yes)								
No	0.93		0.91		1.00		1.00	
Missing	0.89		0.84		0.94		0.91	
Frequently went to bed hungry (vs. no)								
Yes	0.95		1.05		0.97		0.99	
Missing	0.92		1.43	*	0.98		1.48	*
Own schooling (yrs)	0.97	***	0.99		0.96	***	0.98	
House ownership	1.00		1.01		1.03		1.01	
Self-rated economic status (1-5, 1=very poor)	0.88	***	0.99		0.87	**	0.99	

Table 2.6 (continued)

Risk Factors	Difficulties with ADL and with only IADL (vs. nondisabled)							
	Model 1				Model 2 (Model 1+province)			
	IADL only (RRR)	p	Any ADL (RRR)	p	IADL only (RRR)	p	Any ADL (RRR)	p
Province (vs. Guangxi)								
Beijing					3.89	***	14.00	***
Tianjian					4.31	***	29.11	***
Hebei					2.00	*	8.83	***
Shanxi					2.60	**	12.40	***
Liaoning					1.91	***	15.15	***
Jilin					1.86	**	6.31	***
Helongjiang					1.64	*	7.83	***
Shanghai					1.95	***	4.34	***
Jiangsu					1.57	***	3.57	***
Zhejiang					0.92		1.31	
Anhui					1.68	***	2.73	***
Fujian					2.45	***	6.21	***
Jiangxi					1.86	**	2.12	*
Shangdong					3.18	***	12.60	***
Henan					1.32	*	2.71	***
Hubei					2.16	***	3.13	***
Hunan					2.09	***	1.51	*
Guangdong					1.48	**	1.58	*
Chongqing					0.71	*	0.72	#
Sichuan					0.99		0.92	
Shaanxi					1.53	#	8.21	***

Note: #p < .10, *p < .05, **p < .01, ***p < .001

Table 2.7 Multivariate Associations of Risk Factors and "Any 3+ ADLs", 65+ Population, 2008/09 (Odds Ratios reported; N = 15770)

Risk Factor	Difficulties with 3+ ADLs			
	Model 1		Model 2 (Model1+province)	
	OR	p	OR	p
Demographics				
Age	1.08	***	1.09	***
Age_squared	1.00		1.00	
Gender: male	0.82	*	0.76	**
Ethnicity: Han	1.47	*	1.18	
Health Conditions and Behaviors				
Proxy response	1.16	***	1.16	***
Chronic diseases: (vs. no)				
Yes	1.50	***	1.57	***
Missing	1.55	#	1.62	*
Self-rated health (1-5, 1=very good)	2.47	***	2.60	***
Smoked in the past	0.95		0.96	
Exercised in the past	0.93		0.93	
Community Environment				
Residence: (vs. rural)				
City	1.64	***	1.34	**
Town	1.18	#	1.14	
Any social services in community	1.06		1.15	#
Social Support				
Currently married	0.93		0.94	
Socioeconomic Status (SES)				
Father's schooling: (vs. no schooling)				
Some schooling	0.97		1.04	
Missing	1.11		1.10	
Father's occupation when Respondent was a child: agricultural	0.90		0.84	
Adequate medical service in childhood (vs. yes)				
No	0.99		1.01	
Missing	1.05		1.04	
Frequently went to bed hungry (vs. no)				
Yes	1.07		1.04	
Missing	1.47	**	1.42	*
Own schooling (yrs)	1.00		1.01	
House ownership	0.92		0.87	
Self-rated economic status (1-5, 1=very poor)	1.10	#	1.08	

Table 2.7 (continued)

Risk Factors	Difficulties with 3+ ADLs			
	Model 1		Model 2 (Model1+province)	
	OR	p	OR	p
Province (vs. Guangxi)				
Beijing			1.78	*
Tianjian			3.71	***
Hebei			3.58	***
Shanxi			2.85	**
Liaoning			1.78	**
Jilin			2.17	**
Helongjiang			3.87	***
Shanghai			1.25	
Jiangsu			2.06	***
Zhejiang			1.82	**
Anhui			1.71	**
Fujian			2.89	***
Jiangxi			1.37	
Shangdong			2.63	***
Henan			1.41	*
Hubei			1.63	*
Henan			1.34	
Guangdong			0.91	
Chongqing			0.69	#
Sichuan			0.70	*
Shaanxi			1.43	

Note: #p < .10, *p < .05, **p < .01, ***p < .001

"Disability status" outcome

Results of socio-demographic and health-related variables (i.e., variables other than SES) in both multivariate models are consistent with what has been observed in bivariate analysis, with a few exceptions. Overall, socio-demographic disparities in disability are substantial. Respondents who are older, female, and unmarried, have significantly higher risks of ADL and IADL disabilities. Health status is also significantly associated with disability: those who need proxies to answer more ADL/IADL questions, who have chronic conditions or report poor self-rated health are more likely to have ADL and IADL only limitations. Health behaviors in the past do

not show significant effects on disability status at old age: exercising in the past seems to be protective for IADL only limitation, but has no effect on any ADL limitation, while smoking in the past does not show any significant effect on either ADL or IADL only limitations.

City residents, Han people, and residents in communities with any social services are more likely to have any ADL limitation, although when controlling for province, this disadvantage among the Han people disappears.

Most SES differentials become insignificant in multivariate models, with two exceptions: among respondents with more education and higher self-rated economic status a protective effect on mild (IADL only) disability is seen, although the effect size is small with regard to education (*OR = .97*). This finding is similar to what Zimmer (2004) finds, in which all the SES indicators, except for having banking savings, lose strength and significance after controlling for socio-demographic factors.

With regard to province effect, respondents living in almost all other provinces are less likely to report disabilities compared to those living in Guangxi, the reference province (data not shown).

"Any 3+ ADLs" limitation outcome

Multivariate results of "any 3+ ADLs" model are mostly consistent with those of the "any ADL" limitation in general, with these exceptions: (1) none of the SES indicators is significantly related to 3+ ADLs limitation; and (2) being married is no longer protective.

2.4 Conclusions and Discussions

The results of this study confirm findings in the previous literature, which conclude that old age, being female, currently unmarried, and having a poor health condition (e.g., chronic disease and

poor self-rated health) are the key risk factors associated with disability among older adults. Urban elders have a higher risk for ADL limitations. An association between SES and old-age disability exists in China, but seemingly only between a couple of SES indicators (older adult's own education and self-rated economic status) and mild disability (i.e., IADL only limitation). This study also examines a severe type of disability, the 3+ ADLs limitation, and finds that key risk factors are similar for any ADL limitation and 3+ ADLs limitation.

There are several findings from the multivariate analysis that need to be explained carefully:

Ethnicity: in model 1 where province is not controlled for, the majority Han people are found to have higher risks for ADL disability. Previous old-age disability studies (Zeng, 2007; Li, 2009) use the same data and arrive at the same conclusions. This contradicts the perception that Han people generally live in cities, have more resources, are better educated, have better health care access than the minority groups, and, should therefore, have a more favorable disability profile. The CLHLS excludes nine provinces where a large proportion of the residents are minority people, adjusting to accommodate the fact that the minority elderly have significantly higher rates of age misreporting. Minority people who live in the 22 sampled provinces may be highly assimilated into the Han society and are more like Han people in terms of living conditions, health behaviors, and SES. In fact, China has enacted policies in favor of minority groups to ensure their equal rights (Wen, 1998). This may, to some extent, make more opportunities and resources available to minority groups living in the sampled provinces, where such policies are implemented.

Residence: in both multivariate models, older adults living in the cities are significantly more likely to report ADL disabilities. This urban disadvantage, as explained by previous studies

(Lowry, 2010; Zeng, 2010), may be associated with worse air quality in the cities, as well as with the fact that rural residents participate more in outdoor and farming activities. It may also relate to the fact that the prevalence of chronic conditions is higher among urban residents (He, 2007).

This finding is consistent with Li (2009) and Zeng's (2007) studies, both of which also use the CLHLS, but inconsistent with other two studies (Kaneda, 2010; Liang, 2001) which conclude that urban population is less likely to have ADL limitations than the rural population. While Liang and colleagues (2001) focus on a single province, and therefore, their findings may not be generalized to the national population, Kaneda (2010) differs from my study with regard to the survey data, SSAPUR, that they used. A few studies and news releases about the findings of SSAPUR generally report that rural residents have higher risks of disability. Studies using SSAPUR and CLHLS generally have reached different conclusions about urban verses rural disability risks. Although exploring how these two surveys are different from each other is outside of the scope of this dissertation, it is possible that factors such as different ways of defining urban/rural areas may cause different conclusions (Zhu, 2011).

Urban and rural older adults seem to have different risk profiles with regard to IADL only and ADL limitations: urban older adults are more likely to report severe disabilities (i.e., any ADL and 3+ ADLs limitations) but less likely to report mild disabilities (i.e., IADL only limitations). Using an overall disability indicator which combines IADL only and any ADL limitations, that is, any ADL/IADL limitation, I also examine the residence effect on this combined disability status. Results show that rural residence is marginally associated with a higher risk of any ADL/IADL limitation *($p = .067$)*.

Province: compared to those living in the reference province, Guangxi province, older adults in almost all other provinces are more likely to report disabilities. This could be related to different environmental pollution levels across provinces. Guangxi is well known for its natural scenery and clean air. Although not having been documented in literature, unofficial reports show that air quality in a few cities in Guangxi takes the national lead. According to WHO's urban outdoor air pollution database (WHO, 2011a), in 2009 air quality in Nanning, the province capital, was better than most other cities in China (except for Haikou and Lhasa which were not included in the CLHLS sample provinces). Studies have shown that air pollution affects our health in different ways, such as irritating breathing, triggering asthma symptoms, and causing lung and heart diseases (WHO, 2011b; Prüss-Ustün, 2011). These health conditions may lead to functional limitations at old age.

Any social services in community: in both bivariate and multivariate analyses, this factor is positively related to any ADL disability, indicating that respondents living in communities with social services have a higher risk of disability, which seems counterintuitive. This may be partly explained by the fact that cities always offer more social services so people who most need those services may move there.

As mentioned previously, I perform the analyses with and without controlling for a proxy response variable. There is a general consensus that when investigating the oldest old, proxy respondents should be used to avoid biasing the data in favor of healthy older persons (Rodgers, 1992). Studies suggest that spouses may be accurate proxies for the elderly in evaluations of health care (Elliott, 2007). Except for reporting that 90% of proxies are close relatives, such as a spouse, children, and grandchildren (Gu, 2007), the CLHLS does not provide information about exactly whom the proxies are. Similar to studies in the West (Schoeni, 2001), a large effect size

of proxy response on disability status (even larger than the age effect) is found, and since we do not know why the older adults need a proxy to answer the question, the endogeneity factor cannot be excluded: older adults with disability need more help to answer the questions. I further compare results including and excluding the proxy response variable and they are similar (data not shown).

As with all studies that rely on observational data, a limitation of these analyses is the potential for unobservable variables bias. One example of such an omitted variable may be more extensive community characteristics, such as public health environment measured by availability of health care education programs, access to care (i.e., the number of hospitals/clinics in the community), air quality, to name a few. This information is generally not provided in national surveys, and existing studies are usually not able to include it. This study tries to control available variables in the data set as proxy for community characteristics, such as province, residence, and social services, but other important community characteristics that may relate to older adults' disability status are not included. At the present time, based on the analysis of cross-sectional data, we cannot establish a causative relationship through this study, although the study has examined endogeneity issues and excluded endogenous variables from the models.

CHAPTER THREE Projections for the Disabled Elderly Population in China: 2015 – 2050

At some point in their lives, older adults with disabilities may need some type of LTC services, whether formal or informal, and whether in an institution, in the community or in the home. However, before any LTC planning can take place and social resources can be allocated efficiently, policy makers need to know the size of the current and projected disabled elderly populations. Once those numbers are known, policy makers will then be able to estimate the size of the pool of people who will need such services. Using disability indices measured by the ADLs and IADLs, no study in China has been identified yet that provides these numbers.

In this chapter, I develop a prevalence ratio model to project the numbers of older adults with any disability (defined by having any ADL/IADL limitation) and severe disability (defined by having 3+ ADLs limitation) in China through the year 2050. This model answers my second research question: what are the projected numbers of older adults with disabilities in China in future decades (through 2050)? To present the projected growing number of older adults with disabilities who may need LTC against the background of a shrinking youthful population who might provide care, a disability dependency ratio (the number of older adults with disabilities per 1,000 potential formal and informal caregivers) is calculated.

3.1 Purpose of Projections

The purpose of the projections is to provide planners and policy makers with information about the potential size of a specific population (in this case, the number of disabled older adults) based on the best available information about past and current experiences. Projecting the number of older adults with disabilities is challenging, particularly for a time nearly 40 years in the future. Logically, *projections* closer to the present time will be more accurate; the further out in time the

projections are, the more they may be influenced by unpredictable shocks and trends, and the less they will match *actual* estimates.

To account for these uncertainties and to construct valid projections, a variety of possible future scenarios is considered, usually by defining low-, medium-, and high-probability scenarios to cover the likely range of changes in key data inputs (in this case, disability prevalence rates, urbanization rates, and the number of potential caregivers), and to produce the likeliest outcome for each of the scenarios. It is also useful to present multiple sets of projections and to allow the different sets of assumptions to vary, making it clear to planners or policy makers which factors are the most likely to influence the projection outcomes (Beckett, 2007).

3.2 Existing Projection Approaches

Existing projections of the disabled elderly population use two different approaches: one projects the total number of years that individuals will live with disabilities *over the rest of their lives* (Kemper, 2005/06), and the other projects the total number of people with disabilities for a cross-section of the population *at a specific point in time* (Stallard, 1999; Wittenberg, 2008). The foci of the two approaches differ: the first (individual-level) approach answers questions such as, "How many years will these older adults live with disabilities, on average, through the course of their entire lifetime?" The second (population-level) approach answers questions such as, "How many people will live with disabilities in 2020?" Methodologies used for the first (individual-level) approach include life table methods, transition probabilities, and simulations, while the prevalence ratio method is generally used for the second (population-level) approach.

The population-level approach is most commonly used by planners because the method is straightforward and the projection outcomes are easy to use for planning purposes: they provide

a yearly snapshot of the total number of disabled elders who may need LTC, which is sufficient for the planning of future service provisions. The prevalence ratio method is particularly suited to projections of demographic characteristics, such as disabilities, that display strong age associations and patterns.

Only one existing study (Peng, 2010) has been found that projects old-age disability in China. With the objective to estimate the transition probabilities among different self-rated health status they take the first (individual-level) approach using a Markov transition model. Their outcome is the total number of remaining years of "unhealthy" life, calculated by subtracting the discounted years of healthy life from the total remaining years of life. The definition of "unhealthy" relies on respondents' self-reported health status: those who report "fair" or "poor" health status are considered "unhealthy." This study does not provide the numbers of the disabled population.

3.3 Methods

3.3.1 Prevalence ratio method

I take the second (population-level) approach and use a prevalence ratio method to project the numbers of older adults with disabilities in China through the year 2050.

The prevalence ratio methodology involves extrapolating from the current to the future size of disabled populations based on projected changes in demographic characteristics. It separates the changes in the numbers of the disabled into (1) age- and gender-specific population changes (e.g., changes in the numbers of the disabled due to population aging), and (2) age- and gender-specific disability prevalence changes (e.g., changes in the numbers of the disabled because of changes in their risk of having a disability). The product of age- and gender-specific disability

prevalence and the population in each age/gender group is the number of disabled elders at a point in time.

3.3.2 Projection outcomes and data

The numbers of older adults with any ADL/IADL and with 3+ ADLs limitations are projected by age, gender, and urban/rural residence. These numbers are also divided by the numbers of potential caregivers to calculate disability dependency ratios. Compared to the variables used in the risk factor analysis (Chapter 2), the current projections show two deviations. The first is the projection outcome. Instead of projecting IADL only and any ADL limitations separately, to arrive at an overall disability outcome, any ADL/IADL limitation is projected. This outcome represents the overall pool of older adults with disabilities who may have a need for LTC. The second deviation is the residence classification. Instead of city, town, and rural areas, current projections combine city and town as urban areas and conduct projections by using both urban and rural residence. This approach follows Zeng (2007) and Li (2009), both of whom categorize city and town residents as urban residents. This approach also makes it possible to compare the projection results with other studies because all other studies in China categorize residence as urban or rural areas.

The base year for projections is 2008, the year for which the most recent relevant data (disability rates and residence distributions) are available; the projection period is through 2050, the last year for which the U.S. Census Bureau provides a population forecast.[27] The data are drawn from various sources.

[27] Base year data come from 2008/09 CLHLS: the survey conducted the majority (94.9%) of the interviews in 2008 and the remainder in the first half of 2009. Therefore the base year selected is 2008.

Table 3.1 Midyear Population Estimates in 2008 and Projections from 2015 to 2050 in China, by Age and Gender

	2008	2015	2020	2025	2030	2035	2040	2045	2050
Total	1,317,065,677	1,361,512,535	1,384,545,220	1,394,638,699	1,391,490,898	1,378,254,779	1,358,518,748	1,333,892,477	1,303,723,332
Male	679,293,599	700,250,831	709,703,057	711,988,069	707,329,863	697,506,315	684,515,170	669,348,519	651,708,528
Female	637,772,078	661,261,704	674,842,163	682,650,630	684,161,035	680,748,464	674,003,578	664,543,958	652,014,804
Male									
65-69	19,303,021	25,883,446	34,412,524	33,444,446	41,583,483	50,659,953	48,091,318	38,899,730	42,081,338
70-74	15,688,512	17,077,807	22,080,719	29,543,196	28,849,649	36,410,770	44,512,494	42,480,992	34,632,111
75-79	10,242,653	12,133,695	13,085,189	17,148,103	23,264,401	22,902,272	29,570,028	36,377,362	35,022,016
80-84	5,133,769	7,067,943	7,738,785	8,498,701	11,497,617	15,969,934	15,933,817	21,382,403	26,588,931
85-89	1,718,236	2,718,776	3,335,831	3,723,382	4,306,283	6,139,106	8,876,815	9,087,262	12,938,466
90-94	334,376	619,782	825,085	1,053,994	1,267,291	1,583,322	2,437,965	3,744,401	3,992,237
95-99	33,903	68,520	104,871	148,399	211,759	282,236	391,523	668,498	1,115,173
100+	1,684	3,657	5,852	9,658	15,942	26,151	39,966	63,234	121,592
Female									
65-69	18,711,183	25,785,586	35,548,338	34,104,068	43,524,694	52,693,211	50,189,846	40,573,488	43,548,451
70-74	16,111,151	17,670,876	23,363,496	32,403,786	31,209,050	40,219,115	48,837,497	46,706,224	37,950,187
75-79	11,485,222	13,475,108	14,837,383	19,891,831	27,892,730	27,037,431	35,446,976	43,259,186	41,658,424
80-84	6,706,779	8,898,296	9,801,090	11,038,148	15,208,615	21,778,933	21,393,777	28,907,265	35,650,418
85-89	2,795,552	4,082,872	5,066,512	5,748,676	6,812,647	9,852,367	14,654,757	14,773,211	20,973,076
90-94	712,283	1,215,876	1,566,268	2,063,845	2,538,548	3,265,373	5,100,216	8,065,316	8,493,814
95-99	97,023	178,454	265,658	374,984	567,367	787,084	1,140,079	1,989,015	3,439,213
100+	6,693	12,406	19,349	32,474	56,331	102,311	168,943	287,734	576,871
Male 65+	52,456,154	65,573,626	81,588,856	93,569,879	110,996,425	133,973,744	149,853,926	152,703,882	156,491,864
Female 65+	56,625,886	71,319,474	90,468,094	105,657,812	127,809,982	155,735,825	176,932,091	184,561,439	192,290,454
Total 65+	109,082,040	136,893,100	172,056,950	199,227,691	238,806,407	289,709,569	326,786,017	337,265,321	348,782,318

Source: U.S. Census Bureau, International Database

Population projections: the population projections are obtained from the U.S. Census Bureau's International Database (IDB) (Table 3.1). This database is a very detailed source of population projections by gender and by five-year age groups for most countries of the world. It considers age/gender specific mortality, fertility, immigration, and emigration rates, and provides population projections to 2050. This data source is used widely by many international organizations, research centers, academic researchers, and the media. Other sources, such as the UN Population Division also project future populations for China. The UN, however, does not provide the 2008 population estimate which is needed for the base year calculation using the latest estimates of disability rates and residence distributions.

Disability prevalence: point estimates of disability prevalence rates in 2008 are obtained by age group, gender, and residence from regression analyses of the 2008/09 CLHLS data. These estimates are presented in Table 3.2. Trend estimates (2015 – 2050) of disability prevalence rates are determined using the two approaches suggested by Schoeni (2008): the original data analyses (using 2002 – 2008/09 CLHLS) and reviews of existing studies.

Table 3.2 Disability Prevalence in 2008 by Age, Gender, and Residence

	Non-disabled	any ADL/IADL	3+ ADLs	Non-disabled	any ADL/IADL	3+ ADLs
		Male			Female	
65 - 69						
Urban	0.9447	0.0553	0.0081	0.8959	0.1041	0.0111
Rural	0.9343	0.0657	0.0062	0.8775	0.1225	0.0085
70 - 74						
Urban	0.8875	0.1125	0.0137	0.7991	0.2009	0.0188
Rural	0.8679	0.1321	0.0105	0.7680	0.2320	0.0144
75 - 79						
Urban	0.7847	0.2153	0.0231	0.6475	0.3525	0.0317
Rural	0.7521	0.2479	0.0178	0.6046	0.3954	0.0244
80 - 84						
Urban	0.6274	0.3726	0.0388	0.4590	0.5410	0.0529
Rural	0.5836	0.4164	0.0299	0.4139	0.5861	0.0409
85 - 89						

Urban	0.4375	0.5625	0.0644	0.2816	0.7184	0.0870
Rural	0.3930	0.6070	0.0500	0.2460	0.7540	0.0678
90 - 94						
Urban	0.2643	0.7357	0.1051	0.1533	0.8467	0.1397
Rural	0.2302	0.7698	0.0823	0.1310	0.8690	0.1103
95 - 99						
Urban	0.1423	0.8577	0.1669	0.0772	0.9228	0.2170
Rural	0.1214	0.8786	0.1327	0.0651	0.9349	0.1746
100+						
Urban	0.0712	0.9288	0.2547	0.0372	0.9628	0.3209
Rural	0.0600	0.9400	0.2070	0.0312	0.9688	0.2651

Source: 2008/09 CLHLS

Residence: no source has been found for projecting the distribution of the 65+ population by residence. I compare residence distributions from CLHLS and those from another major national survey in China, SSAPUR, and conclude that they are similar and that it is appropriate to use 2008 CLHLS age-gender- specific residence distributions (Table 3.3) as the base upon which the projected residence assumptions can be built.

Table 3.3 Age-Gender-Specific Distributions of Urban/Rural Older Adults in 2008

	Male	Female
65 - 69		
Urban	0.4735	0.4921
Rural	0.5265	0.5079
70 - 74		
Urban	0.4700	0.4806
Rural	0.5300	0.5194
75 - 79		
Urban	0.4693	0.4593
Rural	0.5307	0.5407
80 - 84		
Urban	0.4691	0.4527
Rural	0.5309	0.5473
85 - 89		
Urban	0.4849	0.4659
Rural	0.5151	0.5341
90 - 94		
Urban	0.4977	0.4609

Rural	0.5023	0.5391
95 - 99		
Urban	0.4776	0.4479
Rural	0.5224	0.5521
100+		
Urban	0.6374	0.4475
Rural	0.3626	0.5525

Source: 2008/09 CLHLS

Potential caregivers: the numbers of people at different age ranges are obtained from the U.S. Census Bureau. The UN urbanization projections (Table 3.4) and distributions of 65+ population in rural and urban areas obtained from CLHLS are applied to calculate populations by urban/rural residence.

Table 3.4 United Nations Percentage for Urban Residence Projection in China: 2008 – 2050

Year	% urban
2008	46.1
2015	51.1
2020	55
2025	58.6
2030	61.9
2035	64.9
2040	67.8
2045	70.6
2050	73.2

Source: UN Urbanization Projection

3.3.3 Disability trends

Identifying disability trends in the past can be helpful in making reasonable assumptions about disability trends in the future. Trend studies in developed countries such as the U.S. rely on nationally representative longitudinal data sets (usually 10- 20 years' data) with consistent measures of disability over time (Freedman, 2008; Schoeni, 2008; Freedman, 1998). Similar studies in China do not exist, due to the lack of long-term data providing the needed information. I make disability trend assumptions based on a review of limited trend studies in China (Zhang, 2011; Liu, 2008; Zheng, 2007; Ofstedal, 2007; Gu, 2006), trend studies in the U.S. (Martin, 2009; Schoeni, 2008, 2005; Freedman, 2008, 2004, 2002), assumptions made by existing projections in the U.S. (Smith, 2007; Johnson, 2007; Manton, 2006; Stallard, 1999), as well as a trend analysis of three waves of CLHLS data.

3.3.3.1. Disability trends in China

The existing literature on China does not provide firm evidence of any trend in the prevalence of old-age disability, due to the very limited number of studies, as well as to the lack of nationally representative trend data, and the inconsistent definitions and measures of disability. (Appendix A documents the results of a literature review on disability trends in China and the results of the 2002 – 2008/09 CLHLS trend analysis). Table 3.5 summarizes all findings.

Table 3.5 Disability Trends in China

Disability Measure	Trend Period	Statistical Test	Trend (annual % change)							Population	Data	Setting	Source
			Overall	65-79	80+	Male	Female	Urban	Rural				
ADL measure													
any ADL	1987 - 2006	no	6.3							60+	CSSD	31 provinces	Liu, 2008; Zheng, 2007
	1992 - 2002	yes	-1.0	-0.7	-1.4	-1.7	-0.3	**-2.2**	0.3	65+	Old age su	12 provinces	Gu, 2006
	1994 - 1997	yes	-3.3							60+	Beijing mu	Beijing	Ofstedal, 2007
	2002 - 2008/09	yes	**-10.2**	**-9.4**	**-9.8**	**-8.5**	**-10.2**	**-8.8**	**-10.5**	65+	CLHLS	22 provinces	Author's analyses
individual ADLs	2000 - 2006	no	0.4 - 5.9							60+	SSAPUR	20 provinces	Author's calculations
3+ ADLs	2002 - 2008/09	yes	**-5.2**	0.5	**-4.7**	**-2.8**	**-4.9**	**-3.4**	**-5.3**	65+	CLHLS	22 provinces	Author's analyses
IADL measure													
any IADL	1994 - 1997	yes	**13.7**							60+	Beijing mu	Beijing	Ofstedal, 2007
	2002 - 2008/09	yes	**-4.2**	**-4.4**	**-3.3**	**-3.3**	**-3.9**	**-3.1**	**-4.1**	65+	CLHLS	22 provinces	Author's analyses
IADL only	2002 - 2008/09	yes	**4.2**	-0.8	**5.8**	**2.2**	**5.6**	**4.6**	**4.4**	65+	CLHLS	22 provinces	Author's analyses
individual IADLs	2000 - 2006	no	-0.5 - 13.7							60+	SSAPUR	20 provinces	Author's calculations
Any ADL/IADL													
Any ADL/IADL	2002 - 2008/09	yes	**-5.1**	**-5.2**	**-4.2**	**-4.2**	**-4.8**	**-4.1**	**-4.8**	65+	CLHLS	22 provinces	Author's analyses
Other measures													
visual, hearing, speech, physical, mental, psychological disability	1987 - 2006	no	0.5							60+	CSSD	31 provinces	Liu, 2008; Zheng, 2007
disabled elderly who need care	2000 - 2010	no						1.5	5.1	60+	SSAPUR	20 provinces	Press release

Note: Bold numbers indicate statistically significant at p <.05.

Any ADL trend: mixed findings. Two major surveys in China (the CSSD and the SSAPUR) show that the occurrence of any ADL disability increases annually by a rate of 0.5% to 6.3%. Liu (2008) concludes that the disability rates will increase among the younger cohort (60 – 74) but decrease among older cohort (75+). A recent press release (Zhang, 2011) on SSAPUR concludes that in rural areas the percentage of disabled older adults who need care increases more rapidly than that in urban areas. No statistical tests have been conducted. Three other studies show a declining trend in disability with an annual declining rate of 1% to 10% (Ofstedal, 2007; Gu, 2006; author's analyses of CLHLS data). Gu (2006) and I examine trends for sub-groups. Gu (2006) concludes that urban elders experience a significantly declining trend in any ADL, while among rural elders it increases, but not significantly. My analyses do not show substantial differences (in terms of annual percentage change) among age, gender, and residence sub-groups.

IADL trend: IADL only increases but findings for any IADL are mixed. My analyses of CLHLS data show a 4.7% annual increase for IADL only limitation; this trend is consistent among all sub-groups except for the younger cohort (65 – 79), which shows a 2.3% annual decline. Any IADL limitation declines by 3.7%. Results from SSAPUR show a wide range of trend for individual IADL items, with most items (except for one) increasing by up to 13.7% annually. Ofstedal (2007) shows an annually increasing trend of any IADL at 13.7%.

Any ADL/IADL trend: limited studies. A declining trend is identified by my analysis of three waves of CLHLS data, which shows a 5.2% annual decreasing rate; this trend is consistent among all sub-groups. No other studies on this outcome exist to confirm the findings.

Any 3+ ADLs trend: limited studies. A declining trend is identified by my analysis of three waves of CLHLS data, which shows a 5.5% annual decreasing rate; this trend is consistent among all sub-groups except for the younger cohort (65 – 79), which shows an insignificant 0.5% increase. No other studies on this outcome exist to confirm these findings.

It should be noted that my trend analysis using 2002 to 2008/09 CLHLS data yields a significantly larger trend size compared to some other studies such as Gu's (2006) and Ofstedal's (2007). While I have included all the variables that Gu (2006) and Ofstedal (2007) controlled for (i.e., age, gender, education, marital status, and residence), as well as a few other variables that are associated with the disability status (e.g., ethnicity, health behaviors, chronic conditions), all the studies may be subject to omitted-variable bias due to the use of observational data. For example, none of the studies are able to control for community public health situations measured by availability of community health care education programs, access to health care and long-term care, level of air pollution, and so force. In addition, for both disability outcomes, any ADL/IADL and 3+ ADLs limitations, no other studies have been identified to confirm my CLHLS analysis.

3.3.3.2. Disability trends in the U.S.

The U.S. literature on disability trends is also examined and documented. Table 3.6 summarizes findings from the U.S. literature.

Table 3.6 Disability Trends in the U.S.

Source	Trend Period	Statistical Test	Trend (annual % change)				Population	Findings
			any ADL/IADL	any ADL	IADL only	any IADL		
Freedman, 2002	late 1980s - 1990s	yes	**-0.92 - -1.55**	**-1.38 - 1.53**	**-0.40 - -2.74**		older adults	Systematic review. Any ADL/IADL disability decreased, mostly attributable to decrease in IADL only. Evidence on any ADL is conflicting. Evidence on trends in disparities by age, sex, race, and education was limited and mixed, with no concensus yet emerging.
Freedman, 2004	1982 - 2001	no		-1.00 - -2.50			70+	Comparing trends from 5 different national surveys; a consistent declining trend in any ADL limitation was found.
Schoeni, 2005	1982 - 2002	yes	**-2.15**	**-0.62**			70+	1) Any ADL/IADL limitation among all sub-groups declined; declining rates among better educated, wealthier, younger, and married groups greater than the counterparts; 2) any ADL limitation increased among the lowest income and education groups but decreased among the better educated and wealthier groups.
Freedman, 2008	1995 - 2004	yes	**-0.88**	**-1.46**	1.06	-0.86	75+	Any ADL declined; IADL only and any IADL flat.
Schoeni, 2008	1982 - 2005	yes	**-1.48**				70+	Old-age disability declined.
Martin, 2009	1997 - 2007	yes		**-1.65**	**-2.49**		65+	ADL decrease (total and males), IADL only decrease (total and female). Persistent beneficial effect of education and new evidence of beneficial effect of not smoking had been found. No major effect of obesity on trends.

Note: Bold numbers indicate statistically significant at $p < .05$.

Any ADL trend: declining. Before 2000, Freedman (2002) in a systematic review concludes that evidence on any ADL disability trend is conflicting, and evidence on trends by age, gender, race, and education is both limited and mixed, with no consensus yet emerging. However, Freedman (2004) and Schoeni (2005a) document a declining trend of any ADL (annual percentage change 0.6% - 2.5%); Schoeni (2005b) further concludes that people who have higher SES experience a declining trend while the lowest SES group sees an increasing trend. In general, after 2000, studies show a declining trend (1.5% - 1.7%).

IADL only trend: declining. Freedman's (2002) systematic review documents a significant declining trend of any ADL/IADL disability before 2000, and this declining is largely attributable to a decline in IADL only disability (0.4% - 2.7%). After 2000, Martin (2009) shows a significant 2.5% annual declining rate; Freedman (2008) concludes that occurrence rates of IADL only and any IADL disability are flat.

Any ADL/IADL trend: declining. Almost all studies document a significant declining trend in any ADL/IADL disability prevalence; annual declining rates range from 0.9% to 2.2%.

No studies in the U.S. document a trend in 3+ ADLs.

3.3.3.3. Disability trend assumptions in the U.S.

Table 3.7 summarizes four disability projections in the U.S. that make different assumptions about disability trends.

Table 3.7 Disability Projections in the U.S.

Author /Year	Projection Period	Disability Measure	Scenario	Disability Trend	Justifications for Underlying Assumptions
Smith, 2007	2000 - 2050	any ADL	low	decline by 5% per decade	1) studies on disability trends generally indicating a significant declining trend during 1980s and 1990s (1-2% per year); 2) more public health programs, a growing awareness of regular exercise and good nutrition may suggest recent declines will continue in the future.
			Medium	constant at 2000 levels	Increasing disability rates are at least as convincing as arguments for persistently declining rates.
			High	increase by 5% per decade	1) some other studies on disability trends indicating a significant rising trend; 2) significant increases in the prevalence of some chronic diseases (cancer, diabetes, etc.); 3) disability rates among younger population (40 - 64), who will be the future older adults, did not report declining trends; 4) the pace of educational improvement will slow in future decades therefore slow down the declining trend.
Johnson, 2007	2000 - 2040	any ADL/IADL but <=2 ADLs; 3+ ADLs	low	decline by 1% per year	consistent with Congressional Budget Office (2004) assumptions.
			Medium	constant at 2000 levels	
			High	increase by 0.6% per year from 2000-2014 then constant	consistent with Goldman (2005) assumptions, reflecting recent disability increases at younger ages.
Stallard, 2000	1995 - 2080	1 ADL; 2 ADLs; 3+ ADLs	constant	constant at 1995 levels	
			constant declining	decline by 0.6% per year	1) reflects the effects of expected continued reductions in age-specific disability rates; 2) the 0.6% declining rate is consistent with literature.
			inconsistant declining	age-specific declines of 0.6% per year at 95+, linearly increasing for younger ages	1) reflects the effects of larger continued reductions in age-specific disability rates among younger cohorts; 2) assume that mortality and disability rates have similar patterns of decline: consistent with the age-specific mortality decline rates.
Manton, 2006	2015 - 2080	Any ADL/IADL, or currently institutionalized	Declining	2015 - 2022: -1.7% annually 2022 - 2080: -0.8% annually	Assume 1982-1999 decline rate (-1.7%) will continue through 2022; but assume a conservative declining rate (0.8%) from 2022 to 2080 due to lack of evidence on long-term trend.
			Modest declining	-0.8 annually	Conservative assumption: using the average rate of decline from 1910 to 1999

Smith (2007, page 12) assumes three scenarios (constant, 5% increase per decade, and 5% decrease per decade) based on the belief that "increasing disability rates are at least as convincing as arguments for persistently declining rates." Smith's study makes assumptions by summarizing trends in history but it also considers potential trends in key risk factors for old-age disability, such as the rising prevalence of certain chronic diseases (e.g., cancer, diabetes, etc.), improving health behaviors (e.g., regular exercise), better education of future older adults, as well as the positive effects of public health programs.

Johnson (2007) assumes three scenarios (a constant 0.6% annual increase for the first 15 years and then a constant 1% annual decrease thereafter, permanently). This study selects these numbers based on other studies such as the U.S. Congressional Budget Office (CBO) (2004) and Goldman (2005).

Stallard (1999) also assumes three scenarios (constant, constant declining at 0.6% per year, and declining at 0.6% per year for 95+ but linearly increasing for younger ages). Stallard's assumptions reflect a larger declining trend among the younger cohort; it is also assumed that mortality and disability rates have similar patterns of decline.

Manton (2006) assumes two declining scenarios (1.7% annual decrease for the first 7 years followed by a slower 0.8% decrease rate thereafter, and a constant 0.8% decrease annually). They draw on the aggressive declining assumption when history trend data are available, and make a more conservative assumption when the evidence on long-term trends is not available.

3.3.4 Assumptions

Three sets of assumptions of key data inputs are made (disability rates, urbanization rates, and the number of potential caregivers).

Since trend data are scarce and no previous work has been done in China using ADL/IADL defined old-age disability, disability trend assumptions are made following the approaches that the U.S. literature takes, but the limited findings from China are also considered. Three disability prevalence scenarios are assumed:

1) Declining disability scenario: the prevalence of any ADL/IADL and 3+ ADLs limitations will decrease by 1% per year until the year 2025, when the current younger cohorts (50 – 64) turn 65 to 80 years old. For the years 2026 to 2050, due to the lack of long-term trend data, a conservative annual decreasing rate of 0.8% is applied;

2) Constant disability scenario: the disability prevalence rates by age, gender, and residence that were observed in 2008 will remain constant into the future;

3) Increasing disability scenario: the prevalence of any ADL/IADL and 3+ ADLs limitations will increase by 1% per year until the year 2025, when the current younger cohorts (50 – 64) turn 65 to 80 years old. For the years 2026 to 2050, due to the lack of long-term trend data, a conservative annual increasing rate of 0.8% is applied.

China is experiencing rapid modernization and urbanization, and results from the risk factor analysis (see Chapter 2) indicate that urban and rural residents have different disability risks. To reflect the pace of urbanization in modern China, I also create three residence scenarios for the projections. They are assumed based on the 2008/09 wave of CLHLS data:

1) High rural residence scenario: the percentages of rural older adults in each five-year age group will increase by 1% per year;

2) Constant rural residence scenario: the percentages of rural older adults in each five-year age group that were observed in 2008 will remain constant into the future;

3) Low rural residence scenario: the percentages of rural older adults in each five-year age group will decrease by 1% per year.

To compare the future numbers of older adults with disabilities who may need LTC against the potential future numbers of formal and informal caregivers, three caregiver scenarios are assumed based on people's age and disability status:

1) Low caregiver scenario: total number of people 20 to 64 years old. This scenario assumes that only those aged 20 to 64 would be the potential caregivers;
2) Medium caregiver scenario: total number of people 20 to 79 years old minus total number of people 65 to 79 years old with disabilities. This scenario considers older disabled people may receive care from their possibly nondisabled spouses. Ideally, the number of people 20 to 64 years old with disabilities should be deducted too, but the data are not available;
3) High caregiver scenario: total number of people 15+ years old minus total number of people 65+ with disabilities. This scenario expands the pool of potential caregivers to include (a) young people age 15 to 19 who may provide some care to their elderly grandparents, and (b) all older adults without any functional limitations who also may provide care to their disabled spouses. Similarly, it would be ideal to deduct the number of people 15 to 64 years old with disabilities, but the data are not available.

The numbers of potential caregivers who fit under the three assumptions above are calculated and presented in Table 3.8.

Table 3.8 Numbers of Potential Caregivers under Low, Medium, and High Caregiver Assumptions by Residence: 2008 – 2050

3.8.1 Low Caregiver Scenario (Total number of people age 20 – 64 years old)

	2008	2015	2020	2025	2030	2035	2040	2045	2050
Total	845,532,542	906,226,637	902,903,288	890,402,257	860,601,861	817,912,895	780,013,381	755,316,247	717,303,927
Urban	389,790,502	463,081,812	496,596,808	521,775,723	532,712,552	530,825,469	528,849,072	533,253,270	525,066,475
Rural	455,742,040	443,144,825	406,306,480	368,626,534	327,889,309	287,087,426	251,164,309	222,062,977	192,237,452

3.8.2 Medium Caregiver Scenario (Total number of people age 20 – 79 years old minus total number of people 65 – 79 years old with disabilities)

	2008	2015	2020	2025	2030	2035	2040	2045	2050
Scenario 1. Base (medium rural residence, constant disability)									
Total	921,657,137	999,937,161	1,023,705,945	1,028,912,111	1,023,253,542	1,010,092,607	991,782,019	956,576,905	908,411,159
Urban	426,587,906	508,398,680	555,042,840	588,736,076	611,343,053	623,768,652	631,189,368	630,418,902	617,359,231
Rural	495,069,231	491,538,481	468,663,105	440,176,035	411,910,489	386,323,955	360,592,651	326,158,003	291,051,928
Scenario 2. Decreasing disability (disability rates decrease annually by 1% from 2008 to 2025, and by 0.8% from 2026 to 2050)									
Total	921,657,137	1,001,181,452	1,026,265,125	1,033,313,718	1,028,655,364	1,016,274,016	999,282,091	964,593,864	916,019,065
Urban	426,587,906	508,943,145	556,164,061	590,662,446	613,704,822	626,474,875	634,468,848	633,918,108	620,679,577
Rural	495,069,231	492,238,307	470,101,064	442,651,272	414,950,542	389,799,140	364,813,243	330,675,756	295,339,488
Scenario 3. Low rural residence (percentages of rural older adults decrease annually by 1% from 2008 to 2050)									
Total	921,657,137	1,000,030,141	1,023,898,946	1,029,240,557	1,023,747,263	1,010,763,370	992,694,829	957,639,746	909,507,510
Urban	426,587,906	511,779,267	562,320,496	600,301,858	628,504,005	648,023,699	662,197,124	663,808,548	652,481,435
Rural	495,069,231	488,250,875	461,578,449	428,938,699	395,243,257	362,739,671	330,497,705	293,831,197	257,026,075
Scenario 4. Decreasing disability and low rural residence (combination of scenario 2 and 3)									
Total	921,657,137	1,001,268,116	1,026,436,198	1,033,590,579	1,029,069,881	1,016,834,924	1,000,042,356	965,475,553	916,924,919
Urban	426,587,906	512,364,957	563,583,163	602,565,396	631,389,624	651,445,971	666,484,804	668,529,595	657,087,667
Rural	495,069,231	488,903,159	462,853,034	431,025,183	397,680,257	365,388,953	333,557,551	296,945,958	259,837,253

3.8.3 High Caregiver Scenario (Total number of people age 15+ years old minus total number of people 65+ years old with disabilities)

	2008	2015	2020	2025	2030	2035	2040	2045	2050
Scenario 1. Base (medium rural residence, constant disability)									
Total	1,044,139,216	1,097,203,157	1,110,548,331	1,117,843,969	1,121,423,182	1,113,195,325	1,089,982,252	1,054,558,056	1,012,393,523
Urban	483,256,564	557,853,634	602,059,055	639,527,150	669,772,145	686,636,340	692,528,015	691,918,657	682,564,689
Rural	560,882,652	539,349,522	508,489,276	478,316,819	451,651,037	426,558,985	397,454,238	362,639,399	329,828,834
Scenario 2. Decreasing disability (disability rates decrease annually by 1% from 2008 to 2025, and by 0.8% from 2026 to 2050)									
Total	1,044,139,216	1,099,411,109	1,114,996,338	1,125,247,018	1,130,773,584	1,125,042,797	1,104,539,237	1,071,700,647	1,031,967,419
Urban	483,256,564	558,828,357	604,025,166	642,797,164	673,898,339	691,873,153	698,976,262	699,511,142	691,254,428
Rural	560,882,652	540,582,752	510,971,172	482,449,854	456,875,245	433,169,644	405,562,975	372,189,505	340,712,992
Scenario 3. Low rural residence (percentages of rural older adults decrease annually by 1% from 2008 to 2050)									
Total	1,044,139,216	1,097,333,586	1,110,812,992	1,118,284,236	1,122,101,330	1,114,177,972	1,091,306,669	1,056,205,719	1,014,317,010
Urban	483,256,564	561,643,354	610,112,119	652,295,642	688,931,803	714,266,155	727,860,406	731,511,168	726,425,504
Rural	560,882,652	535,690,232	500,700,873	465,988,594	433,169,527	399,911,818	363,446,263	324,694,550	287,891,505
Scenario 4. Decreasing disability and low rural residence (combination of scenario 2 and 3)									
Total	1,044,139,216	1,099,532,678	1,115,230,930	1,125,618,138	1,131,342,941	1,125,864,510	1,105,642,322	1,073,067,479	1,033,556,691
Urban	483,256,564	562,692,995	612,330,141	656,145,631	693,985,529	720,913,104	736,317,384	741,788,617	738,528,887
Rural	560,882,652	536,839,683	502,900,789	469,472,507	437,357,411	404,951,406	369,324,938	331,278,862	295,027,804

Source: Author's calculation using U.S. Census Bureau population projections, UN urbanization projections, and results from the 2008 CLHLS data analysis

3.3.5 Calculations

The projection model follows six steps that are illustrated below:

Step 1. (estimating the 65+ population by age, gender, and residence in 2008): apply the age-gender-specific distributions of urban/rural older adults in 2008 (Table 3.3) to the population estimates by age and gender in 2008 (Table 3.1);

Step 2. (projecting three sets of 65+ population by age, gender, and residence from 2015 to 2050 under three residence scenarios): vary residence distributions in 2008 (Table 3.3) according to the three rural residence scenarios described previously and repeat step 1 for each scenario to project the 65+ population by age, gender, and residence from 2015 to 2050;

Step 3. (generating three sets of age-gender-residence-specific disability rates from 2015 to 2050): vary age-gender-residence-specific disability rates in 2008 (Table 3.2) according to the three disability trend scenarios described previously;

Step 4. (estimating the numbers of older adults with disabilities in 2008): apply age-gender-residence-specific disability rates in 2008 (Table 3.2) to the results from step 1;

Step 5. (projecting numbers of older adults with disabilities from 2015 to 2050): apply the results from step 3 to those from step 2. This will provide nine sets of population projections under different assumptions about disability and residence trends.

Step 6. (calculating disability dependency ratios between the numbers of older adults with disabilities and the numbers of potential caregivers): because I have three caregiver scenarios, and I report this ratio by two residence categories (urban and rural) and two disability outcomes, this will yield 27 ratios for each disability outcome and each residence category for each year.

To illustrate how various scenarios can affect the projected outcomes, I report the disability dependency ratios by residence under four different disability–residence hypothetical scenarios in 2050, varying the numbers of potential caregivers that might be available to provide formal or informal care. By definition, the larger the ratios, the more disabled older adults there will be who will need caregivers to help support them.

3.4 Results

Tables 3.9 and 3.10 report the total numbers of older adults with disabilities (any ADL/IADL and 3+ ADLs limitations, respectively) and the numbers of older adults with disabilities per 1,000 potential caregivers (disability dependency ratios) in urban and rural areas from 2008 to 2050, under the current status quo (medium rural residence and constant disability trend) and using the medium caregiver scenario. Detailed tables presenting projections by five-year age group, gender, and residence under constant disability and medium residence scenarios are reported in Appendices B, C, and D.

Table 3.9 Total Numbers of Older Adults with Any ADL/IADL Disabilities and per 1,000 Potential Caregivers, by Residence: 2008 – 2050 (Constant Disability, Medium Residence, and Medium Caregiver Assumptions)

	Urban			Rural		
Year	# with disabilities	per 1000 caregivers	65+ Population	# with disabilities	per 1000 caregivers	65+ Population
2008	11,145,115	26.1	51,684,870	14,156,399	28.6	57,397,170
2015	14,347,943	28.2	64,901,326	18,153,179	36.9	71,991,774
2020	17,305,010	31.2	81,709,042	21,844,770	46.6	90,347,908
2025	20,820,583	35.4	94,463,846	26,315,537	59.8	104,763,845
2030	25,720,682	42.1	113,127,778	32,565,165	79.1	125,678,629
2035	31,975,434	51.3	137,287,216	40,364,000	104.5	152,422,353
2040	38,585,529	61.1	154,674,155	48,521,706	134.6	172,111,862
2045	44,545,890	70.7	159,105,323	56,031,447	171.8	178,159,998
2050	50,011,496	81.0	164,408,652	62,640,900	215.2	184,373,666

Table 3.10 Total Numbers of Older Adults with 3+ ADLs Disabilities and per 1,000 Potential Caregivers, by Residence: 2008 – 2050 (Constant Disability, Medium Residence, and Medium Caregiver Assumptions)

	Urban			Rural		
Year	# with disabilities	per 1000 caregivers	65+ Population	# with disabilities	per 1000 caregivers	65+ Population
2008	1,199,034	2.8	51,684,870	1,045,649	2.1	57,397,170
2015	1,565,740	3.1	64,901,326	1,366,203	2.8	71,991,774
2020	1,904,644	3.4	81,709,042	1,657,364	3.5	90,347,908
2025	2,284,358	3.9	94,463,846	1,991,404	4.5	104,763,845
2030	2,820,313	4.6	113,127,778	2,467,320	6.0	125,678,629
2035	3,536,715	5.7	137,287,216	3,096,506	8.0	152,422,353
2040	4,326,048	6.9	154,674,155	3,792,678	10.5	172,111,862
2045	5,068,719	8.0	159,105,323	4,475,971	13.7	178,159,998
2050	5,825,247	9.4	164,408,652	5,166,362	17.8	184,373,666

From 2008 to 2050, even under the constant disability trend assumption, the total number of older adults with any ADL/IADL limitation will increase dramatically, from 25 million in 2008 to 113 million in 2050, almost a 4.5-fold increase. The total number of older adults with 3+ ADLs limitation will increase from 2.2 million to 11.0 million over the same period of time, a 5-fold increase. These increasing rates are shared by both urban and rural areas. Varying the disability trend assumptions will result in larger changes under an increasing assumption (5.3 and 5.9-fold increases for any ADL/IADL and 3+ ADLs limitations, respectively); varying the residence assumptions will result in either a larger change among urban older adults (under the low rural residence assumption) or a larger change among rural older adults (under the high rural residence assumption).

A striking finding is that even under a decreasing disability scenario, there is more than a proportionate increase in the disabled population: from 2008 to 2050, the 65+ population will experience a 3.2-fold increase, while the 65+ disabled population will see a 3.7-fold increase, due to the fact that the 65+ population is getting older over time, and older people are more likely to be disabled. In other words, even if the health care system makes significant progress at

decreasing the prevalence of disability among the elderly, the sheer size of the population is more than enough to increase the total number of disabled elders.

In the coming decades, this rapidly increasing number of older adults with disabilities, together with the shrinking working-age population available to provide care (see Chapter One 1.3.1, Figure 1.5) will lead to a steady increase in the disability dependency ratios nationwide; it will be much more dramatic in rural areas, where young people keep moving out to cities (see Table 3.8). Under the status quo, any ADL/IADL dependency ratio among rural older adults will increase from 28.6 in 2008 to 215.2 in 2050, a more than 7-fold increase. The situation in urban areas seems better, with the ADL/IADL dependency ratio growing from 26.2 in 2008 to 81.0 in 2050 under the same assumptions. Changes in 3+ ADLs dependency ratios reflect the same trend, although, in general, the numbers are smaller.

Tables 3.11 and 3.12 present any ADL/IADL and 3+ ADLs dependency ratios by urban/rural residence in 2050, respectively, under four (disability and residence) hypothetical scenarios. Not surprisingly, the ratios are the most sensitive to changes in the distribution of older adults in urban/rural areas. For example, in any ADL/IADL table (Table 3.11), changing the residence assumption from medium (base scenario) to low (scenario 2) rural residence leads to the ratio increasing by 1.3 times among the urban population under the medium caregiver scenario. Under this low rural residence scenario, even disability rates decrease (scenario 4), the ratio (87.6) will remain almost the same as that under base scenario (81.0). Any 3+ ADLs dependency ratios show similar patterns, although the urban/rural gap is smaller, because urban elders are more likely to have 3+ ADLs limitation. However, under any set of circumstances (including a low rural residence and decreasing disability assumption), the situation in rural areas is projected to be much worse than that in urban areas, because of the rapidly shrinking younger

population in rural areas. Expanding the pool of potential caregivers (i.e., assuming high caregiver scenario) may help to close the urban/rural gap, but not significantly.

Table 3.11 Numbers of Older Adults with Any ADL/IADL Disabilities per 1,000 Potential Caregivers, by Residence, under Four Different Disability, Residence, and Combined Scenarios: 2050

Scenario	Low Caregiver		Medium Caregiver		High Caregiver	
	Urban	Rural	Urban	Rural	Urban	Rural
1. Base (Medium residence, constant disability)	95.2	325.9	81.0	215.2	73.3	189.9
2. Decreasing disability	78.7	269.2	66.6	175.2	59.8	151.9
3. Low rural residence	132.7	213.6	106.8	159.8	95.9	142.7
4. Decreasing disability and low rural residence	109.6	176.5	87.6	130.6	77.9	115.0

Table 3.12 Numbers of Older Adults with 3+ ADLs Disabilities per 1,000 Potential Caregivers, by Residence, under Four Different Disability, Residence, and Combined Scenarios: 2050

Scenario	Low Caregiver		Medium Caregiver		High Caregiver	
	Urban	Rural	Urban	Rural	Urban	Rural
1. Base (Medium residence, constant disability)	11.1	26.9	9.4	17.8	8.5	15.7
2. Decreasing disability	9.2	22.2	7.8	14.5	7.0	12.5
3. Low rural residence	15.5	17.6	12.4	13.2	11.2	11.8
4. Decreasing disability and low rural residence	12.8	14.6	10.2	10.8	9.1	9.5

3.5 Conclusions and Discussions

Drawing from some of the best available data sources and applying empirical analysis when appropriate, this projection provides useful information, especially to planners and policy makers, to understand important future trends of the disabled elderly population in China. Compared with the recent news release about the 2010 SSAPUR results, which claims that by the end of 2010 there were 33 million disabled elders, my estimates of the number of disabled elders for the base year (2008) using CLHLS data are actually very close, considering that SSAPUR includes

60 to 64 younger cohorts and their estimates are two years later than mine. In fact, both estimates may underestimate the true disabled population who may require LTC, because neither estimate includes older adults with functional impairments that are not measured by using ADL/IADL scales (e.g., people with dementia). Studies have shown that the prevalence of dementia has been rising in China (Feng, 2011c; Chan, 2011). If this population is included, the size of the older adults with disability will be even larger.

The results of these projections show that whether or not the prevalence of future disability is rising, declining, or remaining constant, the total numbers of older adults with any disabilities and severe disability will increase remarkably. Although urban residents face the same challenge, the situation in rural areas will be much worse. As young people continue to move from villages to cities for job opportunities and better lives, support for their elderly parents back home will diminish quickly and sharply.

This projection assumes three disability trends to reflect the fact that the future trend for old-age disability is vague. Many factors may be affecting either positively or negatively old-age disability rates in the future. On the positive side, improvements in living standards lead to better access to care and better health status in general. In addition, as the evidence demonstrates in developed countries, further improvements in the SES of new generations of elderly people, including rising levels of education and income and better living conditions can be expected to play a positive role in improving the health and functional status of the elderly (Schoeni, 2008), although this may or may not obtain in developing countries, such as China. On the negative side, the rising prevalence of certain chronic conditions can be expected to reduce functional capacity among the elderly, unless greater efforts are made to address these conditions.

This projection also assumes three residence scenarios to reflect the range of possibilities for elderly population growth in urban and rural areas. On one hand, continuing domestic migration leads to more young people moving from rural areas to urban areas, which may leave more older adults in rural villages. On the other hand, the classification of urban and rural areas may change over time as more towns or even rural areas become urbanized. In this case, even for those who do not move geographically, their urban/rural status may change, which may lead to a larger percentage of older adults living in urban areas. It is also possible that in the coming decades, the strict residence regulations in China that prevent rural residents from legally moving to urban areas will loosen, and more rural elders may choose to move to cities to live with their adult children.

CHAPTER FOUR Developing a Feasible and Sustainable Long-Term Care System in China: Policy Implications

4. 1 Findings of the Previous Chapters

Previous chapters have shown three important trends related to LTC in China in the coming decades:

1) The sheer number of disabled elders who may need LTC will increase sharply in the coming decades, no matter whether the disability rates increase, decrease, or stay constant. A nearly five-fold increase in the number of disabled (defined as having any ADL/IADL) and severely disabled (defined as having 3+ ADLs) older adults is projected from 2008 to 2050, if the status quo is maintained (see Chapter 3). This is driven by rapid population aging and rising prevalence of major chronic diseases.

2) People who are older, female, and/or have chronic conditions are at high risk of having functional disabilities. Compared to their rural counterparts, urban elders are at higher risk of having severe disabilities but at lower risk of having mild disabilities.

3) The ratio of disabled elders to potential caregivers (however defined) will increase rapidly as well, due to continuously shrinking family size. Under any circumstance, the overall LTC situation in rural areas is projected to be much worse than urban areas: fewer children will be available to provide informal care as a result of the one-child policy;[28]

[28] The enforcement of the one-child policy varies in urban and rural areas; in general, it is less strictly enforced in rural areas. For example, in most rural areas, families are allowed to have a second child if the first is a girl or is disabled. For that reason, although both urban and rural areas have fewer children due to the policy, rural residents have been less affected when compared to their urban counterparts.

moreover, young people seeking work continue to move away from rural villages to urban centers and, thus, continue to weaken the existing support system in rural areas.

These findings have important policy implications for LTC in China: in the coming decades, there will be an increasing need for care but a shrinking caregiver workforce, especially in rural areas.

The Chinese government and the society have gradually realized the challenges, and some policy strategies have been taken to address these problems. Recent years have seen growth in the development of institutions and community-based programs initiated by either the government or private sectors (Feng, 2011a; Chu, 2008; Wu, 2005). However, currently there is no national LTC delivery and financing system, although some forms of service delivery do exist (e.g., nursing homes and community-based programs).[29] Long-term care, to date, has not been an urgent policy issue in China, mainly due to the very old tradition that most elders expect to rely on their adult children to provide them with informal care when needed (Zhan, 2011; Fan, 2007). This has always been a two-way expectation: under the requirement of filial piety (i.e., the obligation in Confucian culture and history, in which both elders and their children consider it the children's obligation to take care of their elderly parents). In this way, families are able to cope with changing situations and most elders continue to live at home.

Because parents of the first one-child generation are still relatively young (in their fifties or early sixties), their need for LTC may still be minimal and may not yet have presented itself as a burden to their only child. However, problems do exist. For example, as mentioned in Chapter 1,

[29] A broadly defined LTC system includes LTC policies: standards for disability assessment, the service delivery system, the financing system, coverage and benefit determination, and workforce regulations. This study focuses on the service delivery and financing systems, two essential parts of a broad-based LTC system. Since coverage and benefits determinations are closely related to publicly funded LTC programs, they are also included under the LTC financing system.

the role of the family in providing LTC has weakened along with the growth of the dramatic social and economic changes of the last several decades. Most newly built nursing homes in the cities are privately owned, expensive, and out of reach for low-income elders. In rural areas, many institutions – more than 40% – explicitly exclude older adults with functional disabilities, mainly due to shortages of trained LTC staff or lack of operational funding resources (Zhang, 2011).

The recent national population census (2010) in China indicates rapid population aging (National Bureau of Statistics, 2011). Concerned policy makers and LTC scholars warn that the current LTC situation will not be sustainable (Zhang, 2010). Participants in a recent national LTC development strategy forum in Beijing (*China News*, 2011), including policy makers and private sector stakeholders, expressed their concerns about the current LTC situation and urged the central government to establish national LTC policies that will meet the growing LTC need in future decades.

To succeed, LTC policies must address both the need for LTC and the supply of LTC. Certainly, policy strategies could be developed (and have been developed in many countries) to address the increasing prevalence of disability through the promotion of preventive measures; that is, policies to promote healthier lifestyles. Moreover, better clinical practices can be implemented to improve the management of chronic disease. Both of these strategies may have a downstream impact on the need for LTC. The focus of this chapter, however, is to address LTC delivery and financing, two major concerns in LTC supply policies.

This chapter begins with a brief description of some general principles and common features of LTC systems in other countries. Based on WHO guidelines, I propose a set of guiding principles for a well designed LTC system in China. This chapter ends with some policy recommendations.

4. 2 Common Features of LTC Systems in Other Countries

As a first step toward identifying meaningful policy and design programs that would be both feasible and appropriate to the current Chinese situation, other countries' experiences should be studied. Ideally, those studies should share similar demographic, social, economic, and cultural backgrounds. Information about LTC systems in developed countries is available for OECD countries (OECD, 2011; OECD, 2009; Campbell, 2010; Gibson, 2007; Karlsson, 2004); unfortunately, comparable information about the developing world is largely unavailable (WHO, 2000). Nonetheless, as noted in Chapter 1, China faces many of the same critical LTC issues as the developed countries, such as rapid population aging, rising prevalence of chronic diseases, decreasing family size and changing role of families in providing informal care. For these reasons, examining what has taken place in the developed countries may shed some light on constructing a feasible and appropriate LTC system in China.

The developed world has grappled with the population aging problem for decades, and, many have instituted reforms to their health care and LTC systems as a result. Countries vary in the current size and projected future growth of their elderly populations, political and institutional systems, cultural values, and, consequently, some of their major LTC challenges. However, developments in and revisions to their LTC systems also share many common features, such as the following:

1) In all LTC systems, most of the LTC services are still provided by family caregivers, who are mostly unpaid (OECD, 2011), mainly because of (a) limited public resource and (b) the individual's preference to live independently at home/in the community. To support informal care, there has been a rapid expansion of policies and programs that address elders' needs and enhance the skills of family members who are caregivers.

2) The rates of institutionalization in many nations have dropped (Jacobzone, 2000) and the uptake of home and community-based LTC programs has been increasing. Long-term care systems everywhere are evolving toward greater emphasis on home and community-based services and more involvement by participants and their families in planning and choosing the services that are offered (Merlis, 2000). Many countries have promoted policies that substitute newer, less expensive services for more costly, traditional institutional services, in order to cut expenses and improve patient satisfaction.

3) Long-term care is usually financed separately from the medical coverage system and is evolving toward universal systems. Coverage and benefits for LTC are increasingly determined by the need for care rather than by means-testing.

4) The responsibility for financing and providing LTC services is jointly shared by the government, individuals, and the society (i.e., insurance companies, charity organizations, volunteers, and so forth).

5) Some countries have taken steps to develop assessment systems; they use multidisciplinary teams to coordinate services (e.g., acute care and LTC) by creating

a comprehensive integration of acute and LTC services. Examples are seen in the Program of All-inclusive Care for the Elderly (PACE) in the U.S., the Darlington model in the UK, and the Rovereto and Vittorio Veneto demonstrations in Italy, all of which develop and provide comprehensive community-based medical care, LTC, and other social services by improving the integration and coordination between medical care and long-term care (Johri, 2003).

Despite all of the reforms, no best practice has been identified yet, even in the developed world, and many developed nations face similar challenges. It is a general concern that many nations' LTC financing arrangements appear to be inefficient and inadequately equipped to satisfy the increasing demands for LTC (OECD, 2011).

Although an understanding of LTC needs in the developed world is improving, LTC in developing countries is under-examined and far less widely acknowledged (WHO, 2000). Realizing its increasing importance for developing countries, WHO launched a global initiative in 2002 to search for effective LTC policies and conducted several studies in developing countries. In ten developing countries, case studies of the general health system and then-current LTC provisions were written by local health care experts in 2002 (WHO, 2002a). These studies conclude that for these countries, significant beginnings toward addressing LTC-related issues have been started, with more attention paid to extended family networks and the broader community as sources of support. These case studies also identify significant differences in the strategies applied to meeting the needs of urban and rural populations, because of the larger differences between the urban and rural areas in these ten countries.

4. 3 Guiding Principles of A Well Designed LTC System in China

Recognizing that LTC issues are a challenge worldwide as nations' populations age, the WHO convened policy makers and LTC experts from 11 developed and developing countries to discuss LTC policies for the elderly. Guidelines describing frameworks and principles for policy makers to design their own LTC systems in developed or developing countries were developed (WHO, 2000). Eight priority issues for LTC have been identified, including: 1) personal and public values, 2) private- and public-sector roles and responsibilities, 3) public education, 4) caregiver roles, responsibilities, and rights, 5) infrastructure: LTC systems for providing social and health care, 6) income security and financing of LTC systems and services, 7) current and future technology, and 8) research, data collection, and strategic analysis. Guiding principles for developing comprehensive LTC policies have been developed to address each of these eight issues.

Policy guidelines for LTC in China do not exist. However, two important principles regarding elder care are outlined in the 12th Five-Year (2011-2015) Plan for the Development of China's Aged Population just released (State Council, 2011): the elder care system should focus on the concept of "aging at home" with strengthened community-based care and institutional care, and the entire society should participate in sharing care responsibilities and developing care programs.

A well designed LTC system in China should meet certain universal criteria, such as achieving financial sustainability and reflecting recipients' preferences in terms of how, when, and where the care is delivered; it should benefit from the experiences of existing practices in the developed countries; and probably most importantly, it should fully consider country-specific situations.

Drawing from the experiences of existing LTC systems, summarizing and applying guidelines set by the WHO initiative, and reflecting upon the principles described in the 12th Five-Year Plan in China, the following guiding principles describe what a well designed LTC system in China should achieve over time:

1) Legislation must be in place to direct the development of an LTC system.

2) The system should ensure that all elders who meet defined (LTC) need criteria have access to such services, regardless of age, gender, or income; and the services provided should recognize and address personal values and preferences.

3) The system should balance public and private responsibilities in financing and delivering LTC services to achieve financial sustainability. This includes the following specific goals:

    a. Clearly defined roles and responsibilities for everyone involved in an LTC system (e.g., government, individuals and families, civil society, private sectors, nongovernmental organizations, etc.);

    b. A financing system that requires public and private sectors to cooperate in order to secure budgetary funding;

    c. Well balanced institutional care and home and community-based programs provided by diverse public, private, and nongovernmental organizations;

4) The system should ensure quality of care. This includes establishing a standard of care and an integrated LTC and health care delivery system to link clinical, social, public health, and LTC services.

5) The system should design policies to support informal caregivers, which could take the form of social security coverage, training, respite care, and so forth.

These are long-term goals of a well designed LTC system in China. In the short run, specific country situations should be considered to design feasible policies:

1) The overall challenges in China are expected to be greater than many other countries, because the changes (three trends above) are happening more rapidly;

2) China is still a developing country; compared to developed countries it has less public funding to support LTC;

3) Gaps between urban and rural elders with regard to disability risk profiles and LTC situations are projected to increase sharply if no actions will be taken.

4. 4 Policy Recommendations

China is an enormous country in terms of its population and geographical land mass; it is currently undergoing dramatic demographic, social, economic, and cultural changes. Detailed policy initiatives should be developed that incorporate insights from various stakeholders. However, any LTC policy should fully consider the guiding principles outlined previously. Guided by these principles and learning from other countries' experiences, the following policy recommendations are proposed.

First, *legislative initiatives* specifically intended for LTC are needed to outline the goal of developing an LTC system, regulate different aspects of LTC issues, and define the responsibilities of various parties. Although families will continue to play an important role in providing and financing LTC, responsibilities should also be shared by the government and the

society. Provincial and local governments should be granted certain levels of flexibility in order to fund and develop localized LTC programs.

Second, China should consider a feasible and sustainable LTC *financing strategy*, including a national social LTC insurance program, supplemented with private LTC insurance and sharing LTC financing responsibilities among various parties. The design of the LTC financing system should consider the reform of other relevant policies.

Third, China should build up an LTC *delivery infrastructure* that balances the care services provided in three different settings, with the goal to increase the overall LTC supplies. These initiatives should reflect the urban/rural disparities. Institutional care, still an important part of LTC delivery system, should be strengthened in both urban and rural areas; community-based programs need to be expanded, but may take different forms in urban and rural regions; support services should be provided to informal caregivers.

Projecting globally, for the next several decades the care of the elderly will still be done by family members, in the form of informal care. China will be no exception. However, studies have found that a growing number of elders do not wish to be a burden to their families (He, 2007). This has two implications for LTC policies: (1) community-based programs will offer more options to elders, and (2) this desire may also facilitate elders' acceptance of being institutionalized. Policies, therefore, should consider strengthening institutions, expanding community-based programs, and supporting informal care. Moreover, given that rural older adults and females will face more challenges than their urban and male cohorts, the foci of these policies should be developed differently in urban and rural settings, and should pay more attention to older females' care needs.

Care in homes

Policies to support care in homes should stress providing supportive services to informal caregivers, since they will still be the major source of LTC in the future. Some general approaches suggested by other nations' experience could be adapted in both urban and rural areas, such as (1) arranging financial support for caregivers, either through allowances given directly to the caregivers or cash benefits paid to care recipients so that they can pay their caregivers; (2) establishing care leave and flexible work arrangements to help caregivers balance work and caregiving responsibilities; (3) providing support services for caregivers such as respite care, training, and counseling; and (4) establishing a pension system or old-age benefit programs to increase elders' income, which can be used partly to reimburse family caregivers.

There are also some initiatives that may be considered specifically in the context of China's needs. For example, in urban areas where young female migrant workers are playing an important role as in-home caregivers (i.e., *bao mu*), training and consulting programs as well as initiatives to improve social welfares to this specific population should be developed. As an indirect way to support informal care, especially in rural areas, economic policies should be considered that would generate more job opportunities in towns to attract young people to stay closer to their elderly parents in the villages. Policies should also consider loosening the strict regulations that prevent domestic migrations, so that disabled elders in rural areas can move in with their children living in towns to receive informal care.

As a long-term policy strategy, the one-child policy should be gradually loosened nationwide to increase the availability of family caregivers in the future.

Community-based care

Expanding comprehensive community-based programs offer an efficient way to cover more older adults in urban areas with high population density, but they may not be so efficient in rural areas where populations are scattered. It requires creative thinking about different approaches and programs to provide services in rural areas. One approach is to provide LTC training to rural adult women, who have the greatest potential to organize as a local LTC team for providing services to rural elders. For rural adult women, job opportunities are already limited, which is the main reason so many of them move to urban areas to seek job opportunities. Training local women to provide LTC collectively to rural elders will benefit both the caregivers and the elders who need care. Funding and other support for this approach will largely rely on nongovernmental organizations, volunteers, and township governments. Those rural elders whose adult children have moved to cities for job opportunities may be able to make monetary contributions for LTC from the remittances their adult children send to them. Additionally, for those who live in remote areas where LTC institutions and community-based programs are not economically viable, perhaps home visits by local professionals could be arranged regularly. The training and home visit approach applies in rural areas, given that rural elders are more likely to have mild disabilities rather than severe disabilities and, therefore, the less intensive care should meet their care needs well.

Institutional care

Institutional care will still be an important part in China's LTC system because severely disabled elders will still need care in institutions. Since urban older adults have a higher risk of being severely disabled, as suggested by the results of the risk factor analysis (see Chapter 2), the demand for institutional care may be higher in urban areas. Household income among urban elders is also higher, and the willingness to pay for institutional care is expected to be higher as

well. In these areas, private and international investment in nursing homes should be encouraged to increase supplies of LTC institutions. In rural areas, institutions must be heavily subsidized by the government since private investment is generally less interested in investing in rural areas. This subsidy can be achieved given that the proportion of severely disabled rural elders is lower than that in urban regions, as described in Chapter 2, and, therefore, the demand for institutional care may be lower in rural areas. At the same time, voluntary organizations, nongovernmental organizations, and both domestic and international organizations, should be encouraged to help provide LTC services in rural areas. Admission criteria in rural institutions should be changed to include LTC need assessment, so that functionally impaired elders can be admitted if needed.

In all cases (institutional care and community-based programs), a standard of care should be set up to ensure that quality control is in place. As described in Chapter 1, the quality of service provided in LTC institutions varies, with very few high-quality institutions operating in China (Chu, 2008). Many of the staff working in LTC institutions and community-based facilities are comprised of laid-off workers or migrant workers without any formal LTC training. To ensure a better quality of care, different levels of quality standards for institutions, community-based facilities, LTC professionals, and LTC workers should be established. For example, qualification requirements for professionals (i.e., social workers, registered nurses, program directors) and administrators should be specified: ratios between LTC professionals and the number of elders served in the institutions or facilities should be determined and observed. Minimum training focused on personal care should be provided free to all LTC workers.

4. 5 Dissertation Conclusion

Long-term care needs of older adults with disabilities in China will increase sharply in the coming decades, due to rapid population aging and the increasing prevalence of chronic conditions that contribute to old-age disabilities. The growing number of older adults with disabilities and the shrinking number of potential caregivers may cause a serious imbalance between the need for care and care providers. Compared with developed countries that are facing the same situation but have put long-term policy reforms in place to tackle the LTC problem, China does not have much time or many resources to prepare for this challenge. This dissertation examines the current LTC situation in China, projects the number of disabled older adults who may need LTC against a shrinking LTC workforce in the future, and proposes a set of guiding principles and policy recommendations based on international practices and China's specific national problems. It is both a challenge and an opportunity for the country to develop a well designed LTC system, but the government, the society, the communities, and the individuals should begin to take actions now.

Appendix A. Findings from the Literature on Disability Trends in the U.S. and in China

Very few data exist on old-age disability prevalence over time in China, and very few studies examined trends in old-age disability prevalence. There are two national surveys on disabled people: the China Sample Survey on Disability (CSSD) carried out in 1987 and 2006, and the Sample Survey on Aged Population in Urban/Rural China (SSAPUR) carried out in 2000, 2006, and 2010. Most of the studies on old-age disability in China are based on data analyses of these two surveys. The foci of these two surveys are different: while CSSD focuses on a broadly defined "disability" among populations of all ages, SSAPUR includes disability measures such as, difficulties in performing ADLs/IADLs among old people, which is closer to the disability measures used in the present study. However, using both surveys in 2006, Du (2010) found that the prevalence of disability (defined by CSSD) and the prevalence of any ADL (defined by SSAPUR) were highly correlated.

1. Disability trends identified by CSSD (1987 – 2006)

In CSSD, people with disabilities are referred to as those who suffer from "one or more abnormalities in anatomical structure or the loss of a certain organ or function, (either psychological or physiological), or had lost (totally or in part) the ability to perform an activity in the way considered normal." (Liu, 2008, page 6) Five sub-classifications of disability, including "physical disability," were defined by CSSD. Table A.1 and Figure A.1 show physical disability percentages by age in 1987 and 2006. Using this definition of disability, the prevalence estimates would be substantially lower than the estimates using ADL and IADL, because many people with ADL and/or IADL difficulties do not necessarily meet their definition of "disabled,"

such as having experienced the loss of certain organs or functions. According to CSSD, physical disability prevalence more than doubled between 1987 and 2006.

2. Disability trends identified through SSAPUR (2000 – 2010)

SSAPUR data are available at the aggregate level for 2000 and 2006, and a press release with some key findings for the year 2010.

When comparing prevalence rates of individual items of ADLs (Table A.2) and IADLs (Table A.3) in 2000 and 2006, it seems that the overall prevalence has increased during this period for each ADL item (with a wide range of increasing rates from 2.3% for "bathing" to 35.6% for "indoor walking"), although individual ADL prevalence among younger (65-79) urban residents shows a slight decreasing trend. Unfortunately, I could not find the data on "any ADL," or "any severe (3+) ADLs".

A press release for the 2010 wave survey (Zhang, 2011) also predicted an increasing prevalence of old-age disability.

3. Disability trends identified by other sources:

- Comparing data from the Old Age Support System in 1992 and the CLHLS in 2002, Gu (2006) found that among old people aged 65+ in China, the ADL disability prevalence rate declined from 1992 to 2002, by an annual rate of 1%, with a higher decline rate observed among the oldest old (1.4% for 80+, 0.7% for 65-79), urban elders (2% for urban), male elders (1.7% for male, 0.3% for female), educated elders, and currently married elders.

- Using the Beijing Multidimensional Longitudinal Study of Aging conducted by the Capital University of Medical Science in Beijing, Ofstedal (2007) examined short-term trends in functional limitation and disability among old people in Beijing, from 1994 – 1997. Ofstedal found that Beijing experienced significant increases in the prevalence of IADL limitation, while no significant trend was found with regard to any ADL limitation.

4. Trends analyses using 2002, 2005, and 2008/09 CLHLS (author's analyses)

Using three waves of CLHLS that collect ADL and IADL data consistently, Figures A.2 and A.3 show the percentage of older adults with any ADL/IADL and any 3+ ADLs limitations among the overall 65+ population (Figure A.2) and by age (Figure A.3) in 2002, 2005, and 2008/09. Tables A.4 and A.5 present the results of logistic regressions examining the relationship between a linear trend variable (taking the value of 0 in 2002, 1 in 2005, and 2 in 2008/09) and the two disability measures. The prevalence of any ADL/IADL and 3+ ADLs limitations has seen a decreasing trend from 2002 to 2008/09 among the overall 65+ and across different sub-groups.

Table A.1 Percentages of Physical Disability by Age, 1987 and 2006

Physical Disabilities	Year	Prevalence Rate
60 - 64	1987	1.99%
65 - 69	1987	2.39%
70 - 74	1987	2.66%
75 - 79	1987	2.82%
80 - 84	1987	2.87%
85+	1987	2.63%
All 60+	1987	2.68%
60 - 64	2006	4.14%
65 - 69	2006	5.54%
70 - 74	2006	6.78%
75 - 79	2006	7.85%
80 - 84	2006	8.79%
85+	2006	8.58%
All 60+	2006	6.05%

Source: Liu (2008), CSSD data

Table A.2 Prevalence of Individual ADL Items among the 65+ Population in China, by Age and Residence: 2000 and 2006

	Eating		Dressing		Toileting		Getting to/out of bed		Bathing		Indoor walking	
	2000	2006	2000	2006	2000	2006	2000	2006	2000	2006	2000	2006
Total	3.9%	4.8%	4.5%	5.0%	5.6%	6.7%	5.2%	6.5%	17.3%	17.7%	5.9%	8.0%
Urban												
60 - 64	1.2%	1.2%	1.4%	1.4%	1.7%	1.8%	1.8%	1.5%	5.4%	4.1%	2.4%	1.9%
65 - 69	1.9%	1.9%	2.3%	2.2%	3.1%	3.0%	2.7%	2.8%	9.2%	7.3%	3.8%	3.6%
70 - 74	3.5%	3.1%	3.8%	3.8%	5.3%	4.9%	4.8%	4.6%	15.4%	12.4%	5.8%	5.5%
75 - 79	6.1%	5.0%	7.4%	6.0%	10.4%	8.5%	8.5%	7.6%	29.9%	21.0%	10.0%	9.9%
80 - 84	8.3%	10.4%	10.1%	12.0%	13.4%	16.8%	9.7%	14.5%	41.0%	37.3%	14.0%	17.9%
85+	12.8%	12.3%	19.0%	16.4%	25.6%	21.0%	21.3%	22.0%	55.8%	49.9%	24.8%	24.3%
Subtotal	3.1%	3.7%	3.7%	4.4%	5.0%	6.0%	4.4%	5.5%	14.4%	14.4%	5.5%	6.8%
Rural												
60 - 64	2.2%	2.5%	1.7%	2.2%	1.8%	2.6%	2.1%	2.8%	8.4%	8.2%	2.3%	3.7%
65 - 69	3.3%	4.0%	3.0%	3.0%	3.3%	3.7%	3.1%	3.7%	12.5%	12.0%	3.2%	4.9%
70 - 74	5.0%	5.1%	5.6%	4.0%	7.0%	5.2%	6.7%	5.2%	22.3%	17.7%	6.6%	7.3%
75 - 79	7.2%	7.1%	9.0%	6.7%	9.9%	9.4%	10.2%	9.6%	33.3%	27.7%	9.8%	11.0%
80 - 84	12.4%	12.7%	14.7%	14.2%	19.8%	19.5%	16.1%	19.9%	50.9%	47.2%	18.6%	22.3%
85+	11.6%	15.3%	20.8%	20.0%	24.3%	26.3%	22.2%	24.8%	62.7%	61.6%	25.0%	31.7%
Subtotal	4.8%	5.9%	5.3%	5.6%	6.3%	7.5%	6.0%	7.5%	20.2%	21.1%	6.2%	9.2%

Source: Sample Survey on Aged Population in Urban/Rural China (SSAPUR)

Table A.3 Prevalence of Individual IADL Items among the 65+ Population in China, by Age and Residence: 2000 and 2006

	Cleaning room		Shopping		Cooking		Washing clothes	
	2000	2006	2000	2006	2000	2006	2000	2006
Total	9.5%	11.4%	11.7%	21.3%	22.7%	22.7%	29.0%	28.1%
Urban								
60 - 64	3.4%	2.4%	3.9%	4.7%	6.4%	6.0%	10.0%	8.0%
65 - 69	5.3%	5.0%	8.4%	8.7%	10.5%	9.4%	16.0%	13.5%
70 - 74	8.8%	8.3%	12.7%	14.6%	17.0%	15.2%	23.9%	20.8%
75 - 79	16.2%	14.6%	24.5%	25.1%	30.3%	25.7%	40.3%	33.0%
80 - 84	23.7%	27.9%	37.7%	45.8%	39.4%	46.9%	53.4%	54.8%
85+	44.6%	43.0%	62.4%	65.0%	69.4%	63.2%	72.5%	69.1%
Subtotal	8.6%	10.3%	11.7%	17.4%	15.8%	18.1%	21.8%	23.1%
Rural								
60 - 64	3.7%	3.9%	-	9.7%	16.0%	12.3%	16.4%	14.8%
65 - 69	5.6%	6.1%	-	14.6%	21.1%	19.2%	25.2%	24.0%
70 - 74	11.5%	9.1%	-	22.3%	32.2%	23.3%	43.1%	30.8%
75 - 79	16.3%	16.7%	-	33.4%	45.1%	35.0%	59.5%	43.1%
80 - 84	30.2%	30.7%	-	53.7%	64.5%	54.6%	73.8%	60.7%
85+	43.0%	45.3%	-	72.0%	71.5%	68.5%	85.9%	74.4%
Subtotal	10.5%	12.5%	-	25.3%	29.6%	27.3%	36.2%	33.1%

Source: Sample Survey on Aged Population in Urban/Rural China (SSAPUR)

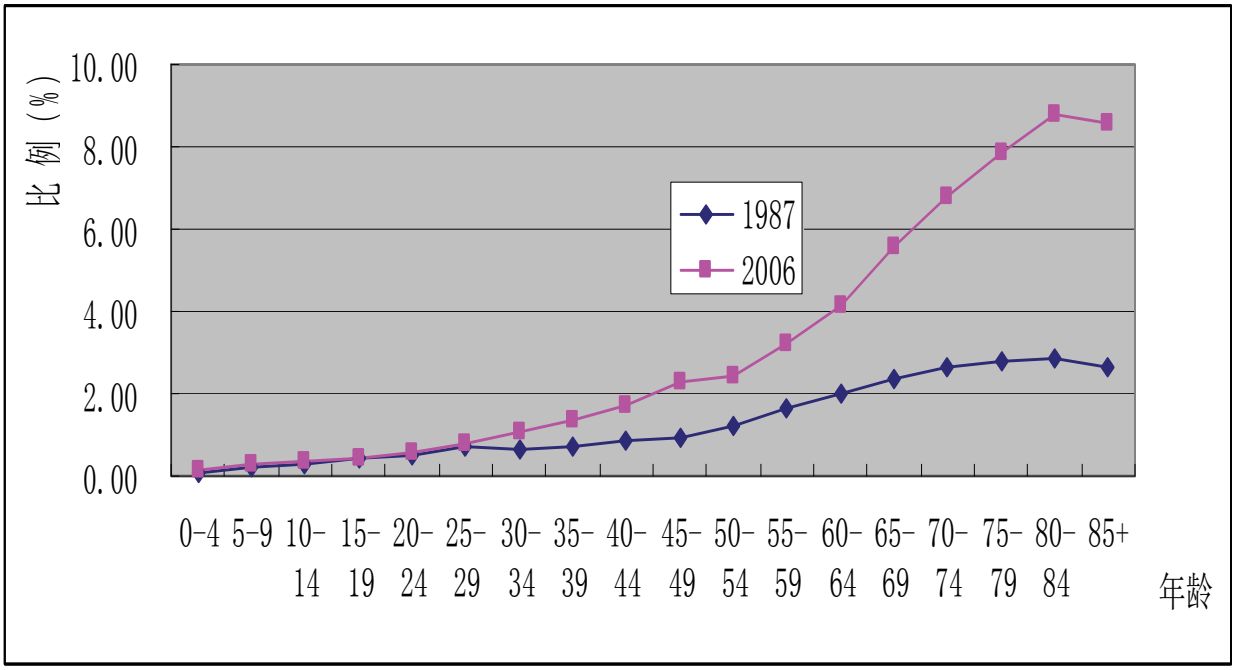
Table A.4 Trend Analysis of any ADL/IADL Limitation in China, 2002 – 2008/09

	Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	p	OR	p	OR	p	OR	p	OR	p
Trend										
All	0.864	***							0.846	***
Age: 65-79			0.845	***						
Age: 80+			0.874	***						
Women					0.857	***				
Men					0.874	***				
Residence: Urban							0.877	***		
Residence: Rural							0.856	***		
Controls										
Proxy response	1.146	***	1.146	***	1.146	***	1.146	***	1.131	***
Age	1.139	***	1.137	***	1.139	***	1.139	***	1.148	***
Age_2	1.000	**	1.000	*	1.000	**	1.000	**	1.000	
Male	0.528	***	0.528	***	0.518	***	0.528	***	0.600	***
Residence_rural	1.132	***	1.132	***	1.132	***	1.160	***	1.051	
Ethnic_Han									1.183	**
Currently married									0.819	***
Chronic condition									1.509	***
Self-rated health									1.745	***
Smoked									1.033	
Exercised									0.903	*
Father occupation									1.000	
Child medical service									0.893	***
Child hungry									0.955	
Schooling									0.978	***
Economic status									0.963	#
test for equality of the trend between groups			65-79 = 80+ p=.25		Women = Men p=.55		Urban = Rural p=.46			

Table A.5 Trend Analysis of 3+ ADLs limitation in China, 2002 – 2008/09

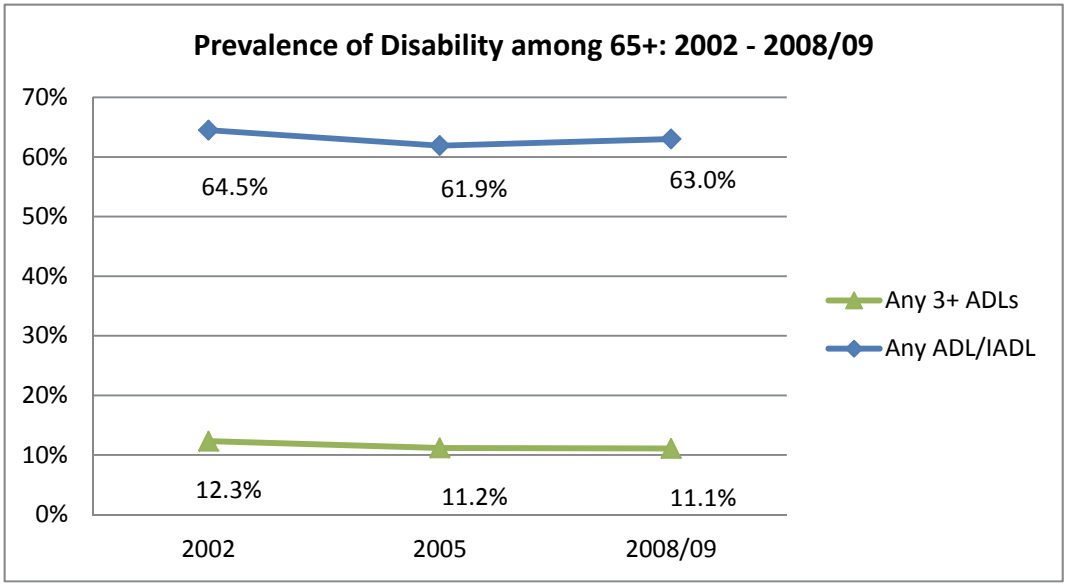
	Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	p	OR	p	OR	p	OR	p	OR	p
Trend										
All	0.868	***							0.844	***
Age: 65-79			1.014							
Age: 80+			0.858	***						
Women					0.854	***				
Men					0.915	*				
Residence: Urban							0.899	***		
Residence: Rural							0.841	***		
Controls										
Proxy response	1.161	***	1.161	***	1.161	***	1.161	***	1.147	***
Age	1.078	***	1.083	***	1.078	***	1.078	***	1.096	***
Age_2	0.999	***	0.999	***	0.999	***	0.999	***	0.999	**
Male	0.749	***	0.749	***	0.701	***	0.748	***	0.719	***
Residence_rural	0.716	***	0.717	***	0.718	***	0.765	***	0.735	***
Ethnic_Han									1.511	***
Currently married									1.053	
Chronic condition									1.673	***
Self-rated health									2.506	***
Smoked									1.035	
Exercised									0.821	***
Father occupation									0.850	**
Child medical service									0.949	
Child hungry									1.100	*
Schooling									1.032	***
Economic status									1.089	**
test for equality of the trend between groups			65-79 = 80+ p=.02		Women = Men p=.12		Urban = Rural p=.10			

Figure A.1 Percentages of Physical Disability by Age, 1987 and 2006



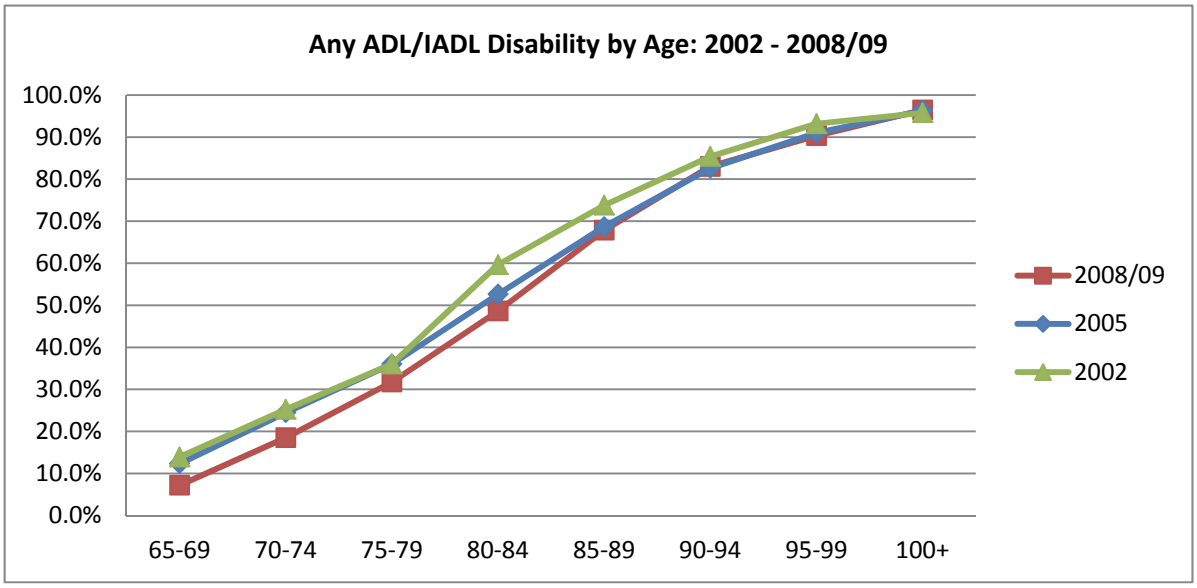
Source: Zheng, 2007 (CSSD data 1987 – 2006)

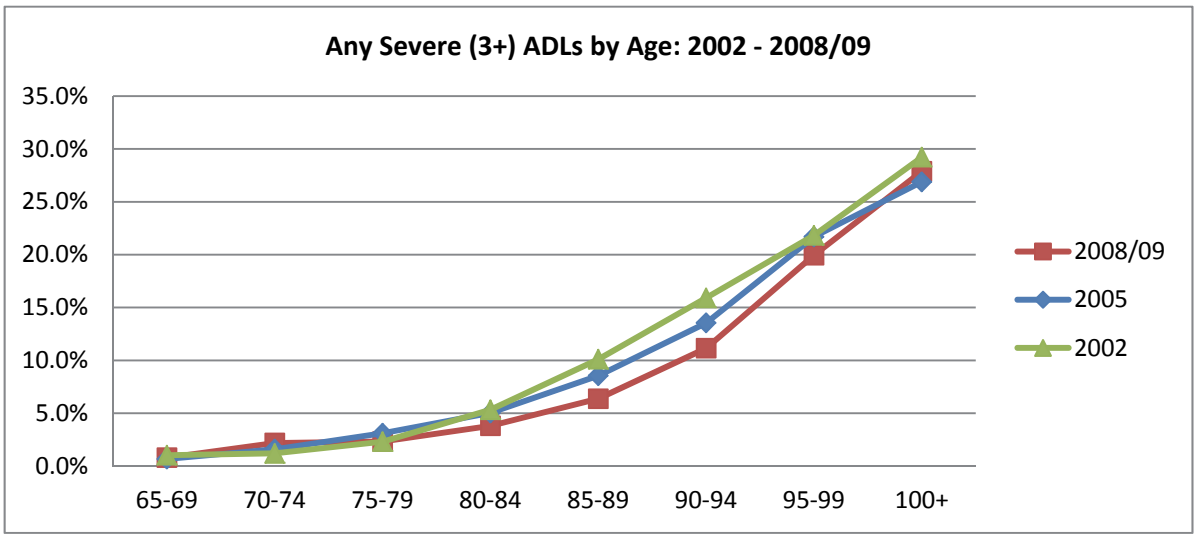
Figure A.2 Percent of the Population Who Have a Disability: 2002 – 2008/09



Source: CLHLS 2002, 2005, and 2008/09

Figure A.3 Percent of the Population Aged 65+ Who Have Any ADL/IADL, and Any Severe (3+) ADLs Limitation, by Age Groups: 2002 – 2008/09





Source: CLHLS 2002, 2005, and 2008/09

Appendix B. Total Numbers of Older Adults with Any ADL/IADL and 3+ ADLs Limitations in China: 2008 – 2050 (Medium Rural Residence Assumption)

	2008	2015	2020	2025	2030	2035	2040	2045	2050
Constant Disability Rates									
Total 65+	109,082,040	136,893,100	172,056,950	199,227,691	238,806,407	289,709,569	326,786,017	337,265,321	348,782,318
Nondisabled	83,780,526	104,391,978	132,907,170	152,091,570	180,520,559	217,370,135	239,678,781	236,687,984	236,129,922
Any ADL/IADL	25,301,514	32,501,122	39,149,780	47,136,121	58,285,848	72,339,434	87,107,236	100,577,337	112,652,396
Urban	11,145,115	14,347,943	17,305,010	20,820,583	25,720,682	31,975,434	38,585,529	44,545,890	50,011,496
Rural	14,156,399	18,153,179	21,844,770	26,315,537	32,565,165	40,364,000	48,521,706	56,031,447	62,640,900
3+ ADLs	2,244,683	2,931,943	3,562,008	4,275,762	5,287,633	6,633,221	8,118,726	9,544,690	10,991,609
Urban	1,199,034	1,565,740	1,904,644	2,284,358	2,820,313	3,536,715	4,326,048	5,068,719	5,825,247
Rural	1,045,649	1,366,203	1,657,364	1,991,404	2,467,320	3,096,506	3,792,678	4,475,971	5,166,362
Declining Disability Rates (1% per year 2008-2025; 0.8% per year 2026 - 2050)									
Nondisabled	83,780,526	106,599,930	137,355,177	159,494,619	189,870,961	229,217,607	254,235,766	253,830,575	255,703,818
Any ADL/IADL	25,301,514	30,293,170	34,701,773	39,733,072	48,935,446	60,491,962	72,550,251	83,434,746	93,078,500
Urban	11,145,115	13,373,221	15,338,899	17,550,569	21,594,488	26,738,621	32,137,282	36,953,404	41,321,758
Rural	14,156,399	16,919,949	19,362,874	22,182,503	27,340,958	33,753,341	40,412,969	46,481,341	51,756,742
3+ ADLs	2,244,683	2,732,763	3,157,310	3,604,224	4,439,374	5,546,858	6,761,960	7,917,875	9,081,764
Urban	1,199,034	1,459,372	1,688,248	1,925,584	2,367,870	2,957,486	3,603,097	4,204,797	4,813,082
Rural	1,045,649	1,273,390	1,469,062	1,678,641	2,071,505	2,589,372	3,158,862	3,713,078	4,268,682
Increasing Disability Rates (1% per year 2008-2025; 0.8% per year 2026 - 2050)									
Nondisabled	83,780,526	102,048,185	127,956,601	143,487,036	169,631,960	203,547,416	222,706,575	216,820,827	213,582,740
Any ADL/IADL	25,301,514	34,844,915	44,100,349	55,740,655	69,174,447	86,162,153	104,079,442	120,444,494	135,199,578
Urban	11,145,115	15,382,758	19,494,067	24,635,922	30,543,806	38,108,717	46,139,616	53,402,237	60,086,794
Rural	14,156,399	19,462,157	24,606,282	31,104,733	38,630,642	48,053,436	57,939,827	67,042,257	75,112,783
3+ ADLs	2,244,683	3,143,440	4,013,760	5,063,804	6,287,256	7,918,826	9,731,072	11,486,061	13,280,274
Urban	1,199,034	1,678,685	2,146,201	2,705,375	3,353,491	4,222,177	5,185,183	6,099,687	7,038,176
Rural	1,045,649	1,464,754	1,867,559	2,358,429	2,933,765	3,696,649	4,545,889	5,386,375	6,242,098

Appendix C. Numbers of Older Adults with Any ADL/IADL Limitation in China by Age, Gender, and Residence: 2008 – 2050 (Constant Disability Rates, Medium Rural Residence)

	2008	2015	2020	2025	2030	2035	2040	2045	2050
					Male				
65 - 69									
Urban	505,412	677,708	901,025	875,678	1,088,783	1,326,433	1,259,178	1,018,514	1,101,819
Rural	667,744	895,379	1,190,423	1,156,934	1,438,485	1,752,465	1,663,609	1,345,647	1,455,708
70 - 74			-	-	-	-	-	-	-
Urban	829,289	902,727	1,167,179	1,561,643	1,524,982	1,924,661	2,352,915	2,245,530	1,830,641
Rural	1,098,631	1,195,920	1,546,262	2,068,842	2,020,275	2,549,763	3,117,108	2,974,847	2,425,207
75 - 79			-	-	-	-	-	-	-
Urban	1,034,806	1,225,856	1,321,985	1,732,457	2,350,381	2,313,796	2,987,433	3,675,172	3,538,242
Rural	1,347,469	1,596,244	1,721,418	2,255,913	3,060,540	3,012,901	3,890,075	4,785,611	4,607,309
80 - 84			-	-	-	-	-	-	-
Urban	897,337	1,235,413	1,352,671	1,485,497	2,009,681	2,791,402	2,785,089	3,737,454	4,647,508
Rural	1,134,931	1,562,522	1,710,826	1,878,822	2,541,798	3,530,500	3,522,516	4,727,044	5,878,060
85 - 89			-	-	-	-	-	-	-
Urban	468,664	741,569	909,876	1,015,584	1,174,575	1,674,494	2,421,227	2,478,628	3,529,077
Rural	537,259	850,109	1,043,050	1,164,229	1,346,491	1,919,580	2,775,608	2,841,411	4,045,608
90 - 94			-	-	-	-	-	-	-
Urban	122,433	226,936	302,109	385,925	464,025	579,741	892,673	1,371,030	1,461,777
Rural	129,294	239,653	319,038	407,551	490,028	612,228	942,696	1,447,860	1,543,691
95 - 99			-	-	-	-	-	-	-
Urban	13,887	28,067	42,958	60,788	86,741	115,611	160,377	273,833	456,801
Rural	15,561	31,451	48,136	68,115	97,197	129,546	179,709	306,841	511,864
100+			-	-	-	-	-	-	-
Urban	997	2,165	3,464	5,718	9,438	15,482	23,661	37,436	71,985
Rural	574	1,246	1,995	3,292	5,434	8,914	13,623	21,553	41,445

(Continued)

	2008	2015	2020	2025	2030	2035	2040	2045	2050
					Female				
65 - 69			-	-	-	-	-	-	-
Urban	958,143	1,320,402	1,820,323	1,746,367	2,228,769	2,698,261	2,570,071	2,077,646	2,229,985
Rural	1,163,705	1,603,683	2,210,858	2,121,035	2,706,932	3,277,150	3,121,458	2,523,388	2,708,410
70 - 74			-	-	-	-	-	-	-
Urban	1,555,727	1,706,338	2,256,030	3,128,979	3,013,613	3,883,644	4,715,854	4,510,054	3,664,552
Rural	1,941,415	2,129,363	2,815,332	3,904,698	3,760,731	4,846,455	5,884,982	5,628,161	4,573,047
75 - 79			-	-	-	-	-	-	-
Urban	1,859,357	2,181,503	2,402,043	3,220,314	4,515,590	4,377,125	5,738,557	7,003,286	6,744,136
Rural	2,455,449	2,880,871	3,172,114	4,252,715	5,963,243	5,780,387	7,578,281	9,248,469	8,906,239
80 - 84			-	-	-	-	-	-	-
Urban	1,642,427	2,179,109	2,400,194	2,703,138	3,724,446	5,333,455	5,239,134	7,079,116	8,730,450
Rural	2,151,200	2,854,129	3,143,700	3,540,487	4,878,165	6,985,595	6,862,056	9,272,008	11,434,875
85 - 89			-	-	-	-	-	-	-
Urban	935,684	1,366,557	1,695,785	1,924,109	2,280,225	3,297,634	4,905,016	4,944,663	7,019,788
Rural	1,125,803	1,644,222	2,040,346	2,315,062	2,743,536	3,967,668	5,901,650	5,949,352	8,446,114
90 - 94			-	-	-	-	-	-	-
Urban	277,964	474,487	611,225	805,401	990,651	1,274,289	1,990,324	3,147,434	3,314,652
Rural	333,702	569,633	733,790	966,903	1,189,300	1,529,814	2,389,431	3,778,568	3,979,318
95 - 99			-	-	-	-	-	-	-
Urban	40,103	73,761	109,805	154,993	234,511	325,327	471,231	822,122	1,421,535
Rural	50,080	92,112	137,124	193,555	292,857	406,268	588,473	1,026,666	1,775,213
100+			-	-	-	-	-	-	-
Urban	2,884	5,345	8,337	13,992	24,271	44,081	72,790	123,972	248,548
Rural	3,583	6,641	10,357	17,383	30,153	54,766	90,433	154,020	308,792

Appendix D. Numbers of Older Adults with 3+ ADLs Limitation in China by Age, Gender, and Residence: 2008 – 2050 (Constant Disability Rates, Medium Rural Residence)

	2008	2015	2020	2025	2030	2035	2040	2045	2050
Male					Male				
65 - 69									
Urban	73,775	98,925	131,522	127,822	158,929	193,618	183,801	148,672	160,832
Rural	62,750	84,142	111,868	108,721	135,179	164,685	156,335	126,455	136,797
70 - 74		-	-	-	-	-	-	-	-
Urban	100,943	109,882	142,071	190,086	185,624	234,274	286,402	273,331	222,829
Rural	87,189	94,910	122,713	164,186	160,332	202,352	247,378	236,088	192,468
75 - 79		-	-	-	-	-	-	-	-
Urban	111,169	131,694	142,021	186,118	252,501	248,571	320,940	394,823	380,113
Rural	96,508	114,326	123,291	161,572	219,201	215,789	278,614	342,753	329,983
80 - 84		-	-	-	-	-	-	-	-
Urban	93,474	128,691	140,906	154,742	209,346	290,777	290,119	389,325	484,125
Rural	81,516	112,228	122,880	134,946	182,564	253,577	253,004	339,519	422,190
85 - 89		-	-	-	-	-	-	-	-
Urban	53,690	84,954	104,235	116,344	134,558	191,828	277,374	283,949	404,288
Rural	44,218	69,966	85,846	95,819	110,820	157,987	228,440	233,856	332,965
90 - 94		-	-	-	-	-	-	-	-
Urban	17,496	32,430	43,173	55,150	66,311	82,848	127,567	195,926	208,894
Rural	13,825	25,626	34,114	43,579	52,398	65,465	100,802	154,818	165,066
95 - 99		-	-	-	-	-	-	-	-
Urban	2,703	5,463	8,361	11,832	16,884	22,503	31,216	53,300	88,914
Rural	2,350	4,750	7,270	10,287	14,679	19,565	27,140	46,340	77,304
100+		-	-	-	-	-	-	-	-
Urban	273	594	950	1,568	2,589	4,246	6,489	10,267	19,743
Rural	126	274	439	725	1,196	1,962	2,999	4,745	9,125

(Continued)

	2008	2015	2020	2025	2030	2035	2040	2045	2050
					Female				
65 - 69		-	-	-	-	-	-	-	-
Urban	102,444	141,176	194,627	186,720	238,298	288,495	274,789	222,140	238,428
Rural	80,938	111,539	153,770	147,522	188,273	227,932	217,104	175,507	188,375
70 - 74		-	-	-	-	-	-	-	-
Urban	145,796	159,910	211,425	293,234	282,422	363,958	441,949	422,662	343,425
Rural	120,837	132,535	175,231	243,035	234,074	301,652	366,291	350,306	284,634
75 - 79		-	-	-	-	-	-	-	-
Urban	167,201	196,169	216,001	289,583	406,060	393,608	516,034	629,763	606,459
Rural	151,413	177,647	195,606	262,241	367,719	356,443	467,309	570,300	549,197
80 - 84		-	-	-	-	-	-	-	-
Urban	160,554	213,017	234,629	264,243	364,079	521,366	512,146	692,012	853,436
Rural	150,072	199,110	219,311	246,992	340,311	487,329	478,711	646,834	797,720
85 - 89		-	-	-	-	-	-	-	-
Urban	113,252	165,403	205,252	232,887	275,990	399,134	593,685	598,484	849,649
Rural	101,204	147,807	183,417	208,113	246,630	356,674	530,529	534,817	759,264
90 - 94		-	-	-	-	-	-	-	-
Urban	45,876	78,310	100,878	132,925	163,499	210,311	328,486	519,458	547,056
Rural	42,368	72,323	93,165	122,762	150,998	194,231	303,371	479,742	505,230
95 - 99		-	-	-	-	-	-	-	-
Urban	9,428	17,341	25,816	36,439	55,134	76,486	110,788	193,284	334,209
Rural	9,353	17,203	25,609	36,148	54,693	75,874	109,902	191,739	331,536
100+		-	-	-	-	-	-	-	-
Urban	961	1,782	2,779	4,664	8,090	14,693	24,263	41,323	82,848
Rural	980	1,817	2,835	4,757	8,252	14,988	24,749	42,152	84,509

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