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Assessment and Prediction of the Demand for Long-term Care for the Elderly in China

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ABSTRACT

Objective: To explore the demand of long-term care in China.

Methods: First, based on the data collected from multiple channels, the number of disabled elderly in China and the long-term care demand were predicted by the macro simulation demand model and markovdo state transition model. The second is to compare and analyze the implementation plan of the long-term care insurance system in China's pilot areas, discuss the existing problems, and put forward Suggestions. **Results:** From 2020 to 2050, the number of disabled elders in China will rise from 33813 700 to 60 535 700, and the total long-term care costs will rise from 6.73 billion yuan to 29.12 billion yuan. **Conclusion:** In the future, China should build a multi-level long-term care guarantee system, actively explore the long-term care insurance system, and improve the long-term care service supply system.

Keywords: Disabled elderly; long-term care; Demand

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With the aggravating aging trend of the population, the number of elderly people increases, and the number of disabled elderly people due to chronic diseases, accidental injuries, etc., is increasing day by day. The elderly people's demand for long-term care services is greatly increasing, and the long-term care of disabled elderly people has drawn great attention from all countries. In 2016, the ministry of human resources and social security issued "guidelines on the implementation of the pilot long-term care insurance system", deciding to launch the pilot long-term care insurance system in 15 cities of China. There are increasing researches and debates on long-term care. This paper mainly deals with how many disabled elderly people need care in China, and how much money they need to spend. It also provides Suggestions for establishing a long-term care security system suitable for China's national conditions, so as to solve the problem of long-term care demand in China in the future.

1. Prediction of the scale of disabled elderly in China

Some scholars have predicted the size of China's disabled elderly population, but the results are quite different. Jing yuejun et al.^[1] (2017) predicted that the total number of disabled elderly in China would reach about 43 million by 2054. Yang mingxu (2018) estimated that the number of ADL disabled aged 60 and above in China will reach 40 million by 2050, based on the data of the three follow-up surveys on the elderly in urban and rural areas. Zhu dawei (2019) et al. calculated based on monte carlo simulation that the number of disabled elderly in China increased from 27,113,000 in 2020 to 65,514, and the total disability rate increased from 10.8% in 2020 to 13.7% in 2050. According to hu hongwei^[2] (2015), the number of disabled elderly in China will reach 219 million in 2050.

1.1 Future population data of China

In this paper, the international population forecasting software padis-int is used to dynamically calculate the age structure change of Chinese population. Main parameters are set as follows:

(1) The project Settings: as the access to the latest population age structure from the sixth census in 2010, so the starting date is set to 2010, end the year of 2050 years.

(2) Starting population: select the statistics of age and sex in China from the sixth census.

(3) Death level: based on the data of Chinese life expectancy published by the sixth census and typical data of software, the prediction was set.

(4) Fertility model: the fertility rate data of Chinese women aged 15-49 in the fifth age group published by the sixth census were used.

(5) Sex ratio at birth: according to the "three-step" strategic plan proposed by the national population and family planning commission on the governance of sex ratio, the problem of high sex ratio at birth should be basically solved by 2020, and it should be brought to a reasonable level (102-107).^[3] The sex ratio at birth in China was 116 in 2010. It is assumed that China will reduce the sex ratio at birth to a reasonable level by 2020, reaching 107, to 105 in 2025 and remaining unchanged after that.

(6) Migration level: considering that China is not a country of immigrants in the traditional sense, the amount of international migration has been relatively small, which is insignificant compared with the huge population size of China and basically negligible. Therefore, the migration level during the forecast period is set as 0, and there is no need to set the migration mode.

The population data results of the high, medium and low programs output by padis-int software were compared with the actual statistical results of China from 2011 to 2018,^[4] and it was found that the output results of the middle program were relatively close to the actual results. Therefore, the elderly population of the middle pro-

gram was selected as the research data (as shown in table 1).

Table 1 total population of China from 2020 to 2050 and proportion of population over 65 years old

Year	Total population (million)	Total population over 65 years old (million)	Proportion of population aged 65 and over (%)
2020	1394	188	13.45%
2022	1401	200	14.25%
2024	1406	211	15.01%
2026	1407	225	16.02%
2028	1407	243	17.31%
2030	1405	263	18.73%
2035	1393	317	22.73%
2040	1372	354	25.81%
2045	1343	364	27.14%
2050	1307	372	28.45%

1.2 Measure the disability rate of the elderly

1.2.1 Data sources

The multi-stage random sampling method used in the China health and old-age care survey (CHARLS) has resulted in a small sample size for this age group, limiting the assessment of disability status for this population. However, the scale and proportion of the elderly in the Chinese elderly health and longevity survey (CLHLS) are relatively high, which reduces the representativeness of the elderly in the middle and young age group who account for a large proportion of the elderly population [5]. In view of the characteristics of the two surveys in the sampling design scheme, this paper combined the two surveys to calculate the proportion of the elderly with different disability levels in the total elderly population in China in 2011 and 2013, that is, the disability rate.

CLHLS and CHARLS for basic life self-care ability measurement project includes meals, control of urine, walking indoors (and the fluctuation bed), toilet, dressing, bathing, etc. In the survey,

if the respondents answered that they could not complete the six activities or needed others to help them complete the main activities to reach 1-3, it would be regarded as partial disability. If 4 items are met or exceeded, severe disability is determined.

This paper calculated the disability rate of the elderly population at all ages based on the combined data. After the merger, the sample size of 2011 was 10,172, of which 76.60% were self-care, 14.75% were partial disability, and 8.65% were severe disability. In 2013, there were 11,262 people, among whom 80.46% were self-care, 13.19% were partial disability, and 7.51% were severe disability.

1.2.2 Calculation of probability matrix of the transfer of disability

In this paper, according to the markov multi-state transition model, the probability matrix of the transfer of disability in the elderly is calculated, that is, the possibility of the health status of the elderly to transfer from one state to another state through T time.

Chinese scholars Peng rong ^[6] (2009), Huang feng et al. ^[7] (2012) and Li xinpings^[8] (2019) have all used this method to conduct relevant studies on the number of disabled elderly people.

Assuming that the health status of the elderly is subject to homogeneous continuous markov stochastic process, $P(T)$ represents the transfer probability matrix after T phase, P represents the transfer probability matrix after 1 phase, $P(T) = P_{ij}(T)$, $i, j=1, 2, 3$, indicating three health states: severe disability, partial disability, self-care. $P_{ij}(T)$ is the probability that an elderly person will go from healthy state i through T to state j . Homogeneous continuous markov stochastic process is expressed as $P(T) = P(T-1) \cdot P = P(T-2) \cdot P \cdot P = \dots = P^T$, which means that the t -phase transition probability matrix for health is equal to the t -power of the 1-phase transition probability matrix.

It is assumed that the changes in the health status of the elderly follow a homogeneous continuous markov stochastic process in which each state can be measured by the ability to take care of oneself in daily life. The health status vectors of the elderly in 2011 and 2013 are defined as row vectors A and B respectively, which are derived from the above.

$A = (0.0865, 0.1475, 0.7660)$

$B = (0.0751, 0.1319, 0.8046)$

The probability matrix of health transition from 2011 to 2013 is denoted as $P(2)$, that is $B = A \cdot P^2$. The transition probability matrix P satisfies that the sum of each row is equal to 1, and each row of P is equal to 1. Since the transfer probability matrix P has 9 elements, but this study only has 6 equations, there are infinitely many solutions. In order to obtain a unique solution, the following additional constraints are selected:

- (1) There is a certain transfer probability between each group;
- (2) The probability of each incapacitated state group remaining in this group is the highest, and the total probability of transferring out is not more than 50%;
- (3) Severe disability to the partial disability group of transition probability is greater than the transfer probability of severe disability groups to self-care, i.e. $P_{12} > P_{13}$, The transfer probability of self-care group to partial disability group was greater than that of self-care group to severe disability group, i.e. $P_{32} > P_{31}$;
- (4) the error between the estimated value $B^{\wedge} = (b^{\wedge}1, b^{\wedge}2, b^{\wedge}3)$ and the true value was less than 5%, i.e. $|b^{\wedge}(i) - b^i| / b^i \leq 0.05$.

Taking the data of 2011 and 2013 as the base years and multiplying by the health transition probability matrix P , the proportion of the elderly in various states from 2020 to 2050 can be calculated, as shown in table 2.

Table 2 proportion of disabled elderly in China from 2020 to 2050 (%)

Year	Proportion of elderly with severe disability	Proportion of partially disabled elderly	Proportion of self-care elderly
2020	6.289%	11.739%	81.978%
2022	6.216%	11.656%	82.136%
2024	6.177%	11.612%	82.220%
2026	6.156%	11.588%	82.266%
2028	6.289%	11.739%	81.978%
2030	6.216%	11.656%	82.136%
2035	6.177%	11.612%	82.220%

2040	6.156%	11.588%	82.266%
2045	6.145%	11.576%	82.291%
2050	6.139%	11.569%	82.305%

1.3 Prediction results of the scale of disabled elderly in China

According to table 1, China's elderly population data and table 2, the total number of disabled elderly people in 2020-2050 can be calculated by multiplying the disability rate of the elderly population (as shown in table 3). Projections show that China's future population will peak around 2030 and continue to decline, while the propor-

tion of the elderly over 65 will continue to rise. By 2050, there will be 372 million elderly, Accounting for 28.45% of the total population, there will be 60.54 million disabled elderly. China's aging problem will become more and more serious, the future should focus on the development of the elderly care and medical industry, the establishment of a timely long-term care insurance system.

Table 3 scale of disabled elderly in China from 2020 to 2050 (million)

Year	Number of elder with severe dis- ability	Number of partially disa- bled elderly	Number of self-care elderly
2020	11.80	22.02	153.76
2022	12.41	23.27	163.96
2024	13.03	24.50	173.46
2026	13.88	26.12	185.45
2028	15.31	28.58	199.61
2030	16.36	30.68	216.16
2035	17.58	33.06	234.08
2040	18.87	35.53	252.20
2045	20.01	37.69	267.93
2050	20.99	39.55	281.36

2. Long-term care insurance demand forecast for disabled elderly in China

In the future, long-term care service delivery will be divided into home-based care and institutional care, and the total cost of long-term care demand for disabled elderly people will include home-based care cost and institutional care cost.

2.1 Cost of home care

According to the calculation of Cao xinbang et al.

^[9] (2014), For home care, the average care time required for partial disabled elderly is 7.5 hours a week, and for severely disabled elderly is 10 hours, and the cost of home care is 1.8 times of labor cost. The 2018 China statistical yearbook shows that at the end of 2017, the average salary per unit of urban employment in China was 39,020 yuan, so the labor cost per hour was about 20 yuan (calculated based on 250 days

and 8 hours of work per person per year), so the cost of home care for partially disabled elderly was 1,080 yuan per month, and the cost of care for severely disabled elderly was 1,440 yuan per month.

2.2 Cost of institutional care

Through online interviews, online inquiries and other methods, a survey was conducted on pension institutions or domestic service companies providing long-term care services for the elderly in China to obtain relevant data on long-term care costs. However, the scale of nursing needs varies from institution to institution, some are divided into three levels of care, some are divided into four levels of care, and even seven levels of care. In view of this, the author intends to make adjustments according to the actual situation. On the basis of taking into account the error factors, it is allowed to fluctuate around 5%, and then calculated and integrated properly. Finally, it is concluded that the cost of institutional care for partially disabled elderly is about 2,000 yuan per month, while the cost of serious disabled elderly

care is about 2,700 yuan per month.

At present, China has not fully implemented long-term care insurance, and there is no data on the choice of long-term care mode. Therefore, the proportion of long-term care mode in this paper is based on German data. In 2013, 70% of the elderly in Germany chose home-based care, and 30% chose institutional care^[10].

According to economics, moderate inflation rate (annual price increase of 3%-6%) can stimulate economic development. Considering the fact that CPI inflation in China has not been high (less than 3%) since 2016, this paper chooses a lower 3% of moderate inflation rate as the growth rate of future per capita cost of care. Combined with the data of disabled elderly calculated above, the long-term care demand cost of China from 2020 to 2050 can be predicted, as shown in table 4. It is estimated that by the middle of this century, the total cost of long-term care needs for disabled elderly will exceed 2921.2 billion yuan, which will bring heavy economic burden to disabled elderly and their families.

Table 4 total demand for long-term care for disabled elderly in China (RMB million)

year	elderly with severe disability		partially disabled elderly		Total disability care costs
	Cost of home care	cost of institutional care	Cost of home care	cost of institutional care	
2018	137140	110210	190430	151140	588920
2020	155900	125280	218270	173230	672690
2022	173990	139810	244710	194210	752730
2024	193850	155780	273330	216930	839880
2026	219020	176000	309220	245420	949660
2028	256390	206030	358960	284890	1106270
2030	290580	233500	408690	324360	1257140
2035	362120	290990	510570	405220	1568890
2040	450520	362030	636070	504820	1953440
2045	553690	444930	782290	620870	2401770
2050	673290	541030	951640	755270	2921240

3. Problems in China's long-term care guarantee system

3.1 Problems existing in the pilot scheme of

long-term care insurance

3.1.1 The coverage of the insurance group is small, and the nursing grade classification

standard is not uniform

There are three types of people covered by long-term care insurance in China's pilot city. First, it covers only urban employees who participate in basic medical insurance, including pilot cities such as guangzhou and ningbo. Second, basic medical insurance covers urban workers and residents. Pilot cities include changchun, Shanghai, Qingdao and nantong, among which Shanghai has set an age limit of 60 for urban and rural residents. Three is the full coverage type, the pilot city has hubei jingmen^[11]. It can be seen that urban and rural residents in some cities and those who do not pay medical insurance are excluded from the coverage. Not allow to ignore, the low-income groups (town unemployment personnel, migrant workers, infirm, etc.), the income level is low, relatively heavy burden on individuals and families for long-term care, because not in long-term care insurance coverage and it is difficult to benefit from the government public subsidies, exacerbating the long-term care insurance benefit imbalance between in the crowd.

At present, China's long-term care insurance is in the exploratory stage, and there is no unified assessment standard for disability and nursing grade. Most of the pilot cities are based on the score of disability degree of Barthel index rating scale as the criteria for applying for recognition of disability, but these cities have different levels of severe, moderate and mild disability, and there is no unified standard. At the same time, the country has not yet issued a unified nursing grade assessment and classification standard system, and different places to identify the level of disability is not consistent, especially for home care standards and charges more unclear. Each pilot city to enjoy the long-term care insurance treatment personnel's qualification and the nursing grade classification standard is not uniform, will bring the system fragmentation and decen-

tralization and other hidden dangers.

3.1.2 Lack of reliable sources of funds and the fund has sustainability risks

It is estimated above that by 2050, China's elderly population will reach 372 million, and disabled elderly will exceed 60.535,700. In the future, the scale of long-term care expenditure will continue to increase, and it may face the danger that the long-term care insurance fund cannot make ends meet. Most of the pilot areas in China have implemented long-term care insurance of the nature of social insurance, which relies excessively on medical insurance funds and government financial subsidies for fund raising. And at present retiree does not pay cost, but safeguard group is old age to disable retiree mostly; As a result, the capital expenditure of long-term care insurance is increasing day by day, while the capital supply is increasingly insufficient, which inevitably depends on the government's large financial input, which brings great challenges to the sustainability of the long-term care insurance fund, aggravates the national financial burden, and brings adverse effects to the development of the whole national economy.

3.1.3 Commercial insurance lacks policy support and its development process is relatively slow

The development of China's commercial long-term care insurance is facing bottlenecks are as follows: first, the nature of China's long-term care insurance pilot stage is dominated by the government social insurance property, long-term care insurance fund raising is mainly comes from the social medical insurance as a whole fund and government subsidies, the at the system level itself limits the commercial insurance company participation in long-term care insurance system in China is; Second, although the state shall encourage commercial insurance company set up long-term care insurance, but has not yet issued specific policies and measures for commercial

insurance company really in the form of the main body involved in the long-term care insurance system, the core is countries do not have a specific preferential policies and measures to encourage the people and enterprises to buy commercial long-term care insurance; Third, the promotion of commercial long-term care insurance is not strong enough, the public awareness and recognition is not high, commercial insurance companies have fewer products and limited nursing services. These bottlenecks hinder the development of China's commercial long-term care insurance.

3.2 Problems in the long-term care service delivery system

3.2.1 Nursing practitioners have a large gap and generally low comprehensive quality

According to the data from National health Commission, In 2018, the total number of registered nurses in China exceeded 4 million, with the medical care ratio changing to about 1:1.6. However, as China enters an aging society, the aging population is soaring, and the number of the elderly over the age of 65 in China is up to 167 million, accounting for 11.9 percent of the total population. At the same time, long-term care insurance is still in the pilot stage in China, and various service standards have not been completely unified. The lack of unified assessment standards for the grade of nursing service demand, quality and intensity of nursing service, etc., further restricts the development of long-term care insurance industry. The survey found that nursing practitioners are generally affected by high work intensity, low salary, low social identity and other factors, and most nursing staff are generally older, less educated, lower overall quality and professional level and higher mobility, all of which need to be solved urgently.

3.2.1 Insufficient number and unreasonable distribution of care institutions

In 2018, China had 168,000 nursing homes and

facilities of various types, with a total of 7.271 million beds for the elderly, and 31,387,600 disabled elderly people. On average, one nursing home needs to care for 186 elderly people, which is a huge burden. From the scale of nursing institutions, most nursing homes have around 100 beds, and a few have less than 50 or more than 200 beds. However, not all beds are nursing beds, so the scale of nursing institutions is far from the average value. In addition, the Chinese government encourages home care, but it can be seen that there are only 45,000 community service institutions for the elderly, which is obviously insufficient. In China, uneven regional development still exists in the supply of care services, which is mainly reflected in the unbalanced development between urban and rural areas, the shortage of rural care and service institutions, and the absence of remote mountainous areas.

4 Suggestions on improving China's long-term care guarantee system

4.1 Establish a multi-level long-term care guarantee system

(1) Preferentially establish a long-term care assistance system

The long-term care assistance system is aimed at those disabled groups who have insufficient supply capacity of family care services and cannot afford to buy care services. These groups are exactly those who need long-term care services most. The funds for assistance come from financial subsidies from the central government and local governments. The disabled in need of assistance should be assessed strictly according to the family care service capacity and economic purchasing capacity. At present, it is necessary to focus on the severely disabled groups who lack family care and are unable to purchase services. The government can issue care service vouchers to the objects in need of assistance and establish the concept of "supplementing the

demanders", which is conducive to meeting the diverse needs of the disabled on the one hand and fostering the development of the care service market on the other hand.

(2) Actively explore the long-term care insurance system.

At the present stage, the Chinese government should summarize the pilot experience of long-term care insurance in a timely manner and actively explore a long-term care insurance system suitable for China's national conditions. On the financing side, on the one hand, it is necessary to scientifically design the corresponding responsibilities of individuals, enterprises and governments in the financing mechanism, and expand financing channels to introduce charities, social organizations or enterprises willing to pay insurance to provide funds to ensure the source of funds. On the other hand, we should set the premium rate by pursuing the medium and long-term balance of the fund, so as to ensure both the smooth operation of the fund and the stability of the premium rate, so as to avoid the conflict caused by the constant change of the premium rate to the payment group. In the treatment should adhere to the principle of ensuring moderation, act according to one's strength. At the same time, it is necessary to do a good job in defining the disability standard, nursing service market and other supporting measures to follow up. At the same time to formulate specific policies and measures to encourage the development of commercial long-term care insurance, improve residents' awareness of commercial insurance.

4.2 Improve the long-term care service supply system

First, in the future, all regions should be encouraged to give full play to the advantages of community resources, encourage the coordinated development of family, community and institutional pension, establish nursing service institu-

tions that adapt to different service levels and meet the nursing needs of different economic levels, and improve the supply system of long-term care services.

The second is to attach great importance to the development and cultivation of nursing human resources, formulate medium - and long-term plans for personnel training and training, and ensure the quality and quantity of nursing personnel. In addition, it is worth noting that with the increase of average life expectancy, once disabled, it is almost impossible for the elderly to return to self-care status, and most of them turn into severe disability due to old age, illness and other factors. The cost of serious disability care is much higher than the cost of partial disability care. Therefore, China should implement the "care prevention project" in the future, in which health-care providers, rehabilitation therapists and professional nurses provide preventive care services, so as to maintain the status quo of their health and not deteriorate too quickly, so as to reduce the cost of care.

The third is to actively provide family care services, which not only plays an important role in the care of the disabled elderly, but also can greatly save social costs. Current public policy formulation can actively safeguard the role of the family, such as introducing reasonable nursing leave and allowing appropriate leave for family members in need of long-term care; Some subsidies can also be provided for family care providers, such as some unemployed people who provide care services at home can obtain corresponding financial subsidies^[12].

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