

The demand for elderly care services and anticipated living arrangements among the oldest-old in China based on the Andersen model

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Abstract

Background: In China, the issues arising from an aging population are becoming increasingly serious, so research on elderly health has become a topic of discussion. However, few studies have focused on the oldest-old with regards to their existing demand for elderly care services and anticipated living arrangements.

Methods: The data of 4738 participants aged ≥ 80 years were extracted from the Chinese Longitudinal Health Longevity Survey (CLHLS) carried out in 2014. Using the Andersen model as the analysis framework, a multiple logistic regression was used to analyze the relationship between anticipated use of social services and intended residence and influencing factors. Odds ratios (ORs) were calculated to indicate the relationship between the influencing factors and the dependent variables.

Results: From the descriptive analysis results, it is found that oldest-old showed high anticipated needs for care services, such as home visits (83.5%), health education (76.4%). And there exists a huge imbalance between supply and demand for aged care services. Moreover, living with children is still the most important way of providing for the oldest-old (44.4% in urban, 55.6% in rural). The multivariate regression results showed that the demand for elderly care services and anticipated living arrangements among the oldest-old in China are influenced by predisposing factors, enabling factors, and need factors ($P < 0.05$). The oldest-old who are older, without housing property rights, childless, and ADL-restricted are more tend to live in long-term care institutions (ORs > 1 , $P < 0.05$).

Conclusions: The most vital needs of the oldest-old are home visits, health education, and spiritual comfort. There is a huge imbalance between supply and demand. Moreover, living with children is still the most important way of providing for the oldest-old. Demand for elderly care services and anticipated living arrangements are influenced by predisposing, enabling and need factors. Although the family plays an essential role in the healthcare of the oldest-old, the traditional pension model no longer meets the multi-level and diversified healthcare service needs of the oldest-old due to the rapidly aging Chinese population, which requires countermeasures from policy makers.

Background

China is one of the countries with a prominent aging population with a rapid increase in the proportion of people aged 65 and over from 7.0% in 2000 to 11.9% in 2018. This has resulted in a need for China to impose positive measures to slow down the aging of the population. According to the 2017 Statistical Report on National Economic and Social Development, the number of elderly people aged 65 or over in China had exceeded 150 million, amounting to more than one tenth of the total population. The growth of the population aged 60 years or older is occurring in parallel with increasing inequalities in income, disparities in access to healthcare and social-support systems, and widening health gaps as a result of complex patterns of disease burden and globalization of health risks [1]. Given the continuing growth in the older population, planning for the needs of this population remains a challenge for public health practitioners and policymakers alike [2]. In addition, Xi Jinping proposed in the report of the 19th National Congress that the aging of the population should be considered of great importance and suggested that the problem arising due to an aging population could be alleviated by building a comprehensive pension service system. This demonstrates the urgency to solve the aging population problem in China.

Since the implementation of family planning in the late 20th century, the birth rate has reduced greatly. Moreover, with the improvement of living conditions, there has been a pyramid-shaped "Four-Two-One" family model, which represents a pyramid-shaped family comprising paternal grandparents, maternal grandparents, parents and an only-child. For an only-child, supporting the whole family can be a challenge. There are sometimes inevitable conflicts between working and providing for the aged, with current traditional informal family care rarely meeting the multi-level care needs of the elderly, leading to a strong demand for formal community home care services [3]. However, the needs and costs of home-based care for the disabled oldest-old, aged 80 and over, would increase much faster than that for the disabled young-old, aged 65-79, after 2030 [4]. One survey aimed to identify the factors that jointly influenced healthcare utilization among older people in China, with a view to reducing inequalities in health services use [5]. And the long-term care (LTC) services in China could be a supplement of residential and community-based home care services [6]. Previous literature has shown [7-10], living arrangements have long been regarded as the foundation of oldest-old care and are closely connected with the physical and psychological well-being of the oldest-old and

social resource allocation. Living in a nursing home is a good option for the Chinese elderly care according to explore the impact of the discrepancy between actual and preferred living arrangements on life satisfaction among the oldest old in China [11]. Interestingly, the different intergenerational household composition had varying effects on quality of life (QoL) and health-related quality of life (HRQoL) in the oldest-old; the oldest-old living in a three-generation family with an unmarried adult child had the poorest QoL/HRQoL compared to any other type of living arrangement [12]. Greater deterioration was found among people living in a community setting versus those living in residential care centers [13].

Older people, as one of the disadvantaged groups, may suffer from rapid deterioration in their own physical conditions. For the oldest-old, they may be more poor in self-care, resulting that it is easy to produce negative emotional experience, reducing the quality of life [14]. In addition, with the rapid transformation of Chinese society and the aging population, the proportion of oldest-old families living alone has increased. Older left-behind and intergenerational families are also becoming more common. Since senior citizens experience problems more commonly than other groups, care for the oldest-old requires greater consideration. At present, there is limited comprehensive explorations of the demand for diversified aged care services and living arrangements for the oldest-old in China. Studies focused on people over the age of 80 is particularly limited. Therefore, based on the 2014 Chinese Longitudinal Health Longevity Survey (CLHLS) database, we sought to investigate the willingness and influencing factors of demand for elderly care services in the oldest-old (aged 80 and over) in China. We also explored living patterns, which may represent countermeasures for the development of elderly care services. We propose to make evidence-based recommendations for further improving the development of the pension service system in China and lend new insight into addressing issues relating to the aging population worldwide.

Methods

Data source

The data was extracted from the CLHLS conducted by the Healthy Ageing and Development Research Center at Peking University, China. The CLHLS was a high-quality, nationally representative survey, carried out in a random half of the counties and cities in 22 of 31 provinces, covering approximately 85% of the total population of China [15]. The survey was carried out using face-to-face interviews in respondents' homes. It provided a rich set of information on socioeconomic and demographic characteristics, health-related behaviors and lifestyles, ways of living, and care needs of the population with functional limitations. For the purpose of this study, 4,738 individuals aged 80 or over were selected from respondents. (The questionnaire used in this study has previously been published in [https://www.icpsr.umich.edu/icpsrweb/DSDR/studies/.](https://www.icpsr.umich.edu/icpsrweb/DSDR/studies/))

Andersen Theoretical Model

Andersen's behavioral model of health services use has been applied in several studies investigating utilization of health services, health-related quality of life, and long-term care services of the elderly [16]. It showed the effects on use of health services depending on predisposing (i.e., age, gender, education, ethnicity, and family), enabling (i.e., financial resources, residence, social support network), and need components (i.e., health status and activities of daily living [ADL]) (Andersen, 2008). Because this model comprises a variety of factors that may influence the pension system, it can be adopted as an analytical framework to explore problems arising from an aging population. To date, there has been little research using the Andersen model as a theoretical framework for the demand for elderly care services and anticipated living arrangements among the oldest-old in China. We adapted Andersen's model to suit China's aging population landscape. The adapted model of influencing factors of pension demand and residence intention include: (1) predisposing factors, including place of residence, gender, age, marital status and education level; (2) enabling factors, including current living arrangement, housing property rights, number of children, primary caregivers and economic status; and (3) need factors, including self-evaluation of health, loneliness, and ADL.

Dependent Variable

To gather data on anticipated living arrangements (i.e. residence intention), each participant was asked the question, “what kind of living arrangement do you like best?” One selection was made from a possible four answers: (1) living alone or with spouse regardless of how far away your children live; (2) living alone or with spouse with children living nearby; (3) co-residing with children; or (4) in a LTC institution. To measure the demand for elderly care services, Participants were asked to describe their expectations about their demands for care services with respect to eight elements of care: (1) personal care services, (2) home visits, (3) psychological consulting, (4) daily shopping, (5) social and recreation activities, (6) legal aid, (7) health education, and (8) neighboring relations.”

Independent Variables

The Andersen theoretical model of influencing factors on care services need and residence intention among the oldest-old was adapted according to the research purpose and the availability of survey information. The predisposing variables were residence (1=urban, 2= rural), gender (1=male, 2=female), age group (1=aged 80-89, 2=aged 90-99, 3=aged 100+), marital status (1=married, 2=divorced, 3=widowed, 4=never married), and educational background (1=no formal education, 2=elementary school, 3=middle school and above). The enabling variables were expressed by current living arrangement (1=family, 2=living alone, 3=nursing home), housing property rights (1=own, 2=rent, 3=other), number of children (1=none, 2=1~2, 3= ≥ 3), primary caregivers (1=family, 2=others, 3=nanny, 4=none), and economic status (1=poor, 2=fair, 3=rich). The need variables were measured by self-rated health (1=bad, 2=fair, 3=good), feeling lonely and isolated (1=always/often, 2=sometimes, 3=seldom/never), and ADLs (1=strongly limited, 2=limited, 3=not limited).

Data Analyses

The results from this study were computed using Stata 14.0 for Windows 10. Descriptive statistics were used to observe the distribution characteristics of anticipated living arrangement and care services need among some sub-group divided by age, sex, gender and so on. Logistic regression analyses were completed for each outcome variable of individual residence intention and elderly care service based on the Andersen model. The odds ratios and 95% confidence interval indicated the effect of each predictor and whether it met statistical significance. A value of $P < 0.05$ was considered statistically significant.

Results

Descriptive analysis

We included 4738 participants in our study, comprising 2207 octogenarians, 1654 nonagenarians, and 977 centenarians. Among the oldest-old, 41.3% were male, 58.7% were female. Urban residents accounted for 43.8%, while rural residents accounted for 56.2%. 67.4% respondents did not provide educational background. 76.4% lived with their family. The descriptive characteristics of the study sample are shown in Table 1.

Through the investigation of the needs and supply of care services for the oldest-old, we found that among Chinese oldest-old aged 80–89 years, 90–99 years, and 100+ years, 59.4% (2710) require daily care, 83.5% (3826) require home visits, 65.0% (2963) require spiritual comfort, 56.4% (2566) require daily shopping, 62.5% (2,839) require social entertainment activities, 59.7% (2,704) require legal aid, 76.4% (3473) require health education, and 62.4% (2831) require neighboring relations. The order of demands was ranked from high to low as follows: home visits, health education, spiritual comfort, social entertainment activities, neighboring relations, legal aid, daily care, daily shopping (as shown in Figure 1). The oldest-old were most in need of home visit services. Communities provided daily care for only 5.5% of the oldest-old, 8.6% for spiritual comfort, 10.9% for daily shopping, and 17.7% for social entertainment activities, 24.8% for family and neighborhood disputes, 36.3% for on-site service, and 39.1% for health education. These results are shown in Figure 1. There exists a huge imbalance between supply and demand in daily care, home visits, and spiritual comfort.

Among the three age groups, most of the oldest-old chose to live with their children. The older they were, the more this was the case. Less than 5% of the oldest-old chose to go to long-term care institutions. Compared with oldest-old people living in urban areas, the proportion of oldest-old living in rural areas who chose to live with their children was higher. The detailed results of the living arrangements of different age groups and residence are presented in Table 2.

Logistic regression analysis

Multiple logistic regression was adopted to analyze the factors influencing the demand for various aged care services. The results showed that the demand for aged care services for the oldest-old was influenced by age, residence, education, living arrangements, housing property rights, economic status, self-evaluation of health, loneliness and activities of daily living (ADL), summarized in Table 3. Furthermore, the odds ratios of oldest-old care services were calculated to identify the direction of correlations. Table 3 shows that compared with those aged 80-89, those aged 100 or over were more willing to enjoy daily care services (ORs=1.196, $P<0.05$). Those people aged 80-89 had higher demand for social and recreation activities than the other age groups (ORs=0.812, 0.869, $P=0.05$). The elderly living in rural areas were in more need of home visit services than those living in urban areas (ORs=1.437, $P<0.001$). The oldest-old without formal education were in more need of home visits and neighboring relations services than those with seven or more years of schooling (ORs= 0.599, 0.712, $P<0.05$). For living arrangements, the oldest-old who were living in nursing homes or living alone had a higher need for the eight care services than people living with their family (ORs=1.178-4.216, $P=0.001$). In contrast to those who own a house, those with other housing property rights had less need for home visits, health education and neighboring relations (ORs=0.595,0.504, 0.700, $P<0.05$). Those who rented a house were less in need of legal aid (ORs=0.692, $P<0.05$). Compared to high socioeconomic status individuals, those with low socioeconomic status needed more daily care services (ORs=0.692, $P<0.01$). The oldest-old with good self-reported health had lower demand for all care services except legal aid (ORs=0.712-0.805, $P<0.05$). Compared to those who always or often felt lonely and isolated, those who rarely did were more inclined to engage in social and recreation activities and require legal aid services (ORs=1.347,1.277, $P<0.05$). Oldest-old people who felt lonely and isolated some of the time needed more daily care, home visits, psychological consulting, social and recreation activities, legal aid, and health education services (ORs=1.389-1.628, $P<0.05$), but had less need for daily shopping (ORs=0.940, $P<0.05$). Those who did not have limited ADL had higher demand for social and recreation activities, health education, and neighboring relations than those with highly limited ADL (ORs=1.313, 1.423, 1.377, $P<0.01$).

In addition, the analysis of factors influencing anticipated living arrangements showed residence intention for the oldest-old is influenced by age, gender, education, housing property rights, number of children, economic status, sense of loneliness, and ADL (Table 4). Using "living alone or with spouse regardless of how far away children live" as the reference, the results showed that compared with those people aged 80-89, those aged 100 or over were more likely to be living with their children or living in LTC institutions and were reluctant to live alone (ORs=0.311, 0.353, $P<0.05$). Elderly women were more inclined to co-reside with their children than men (ORs=0.904, $P<0.001$). The oldest-old without formal education were more likely to respond with, "live alone (or with spouse) but it is better that children live nearby" and "live with children," than those with 7 or more years of schooling (ORs= 1.567, 1.506, $P<0.05$). For housing property rights, those who did not own or rent a house tended to live in nursing homes (ORs=0.039, 0.027, $P<0.001$). Compared to people who had three or more children, those without children were more likely to live in a nursing home (ORs=10.297, $P<0.001$). The oldest-old with low economic status were less likely to live with their children than those with high economic status (ORs=0.734, $P<0.05$). The oldest-old who sometimes felt lonely and isolated were more inclined to live alone (or with their spouse), with children living nearby, than those who never or seldom felt lonely and isolated (ORs=1.382, $P<0.05$). The oldest-old who did not have limited ADL had greater intention to live alone, while those with high limited ADL needed to live near or with their children or live in an LTC institution (ORs=1.978, 2.503, 2.673, $P<0.05$).

Discussion

The dramatic increase in numbers of the oldest-old is an urgent concern, presenting a major challenge for health and social care systems because of their need for daily assistance and medical care. However, there is a marked imbalance between the supply and demand of elderly care services. The objective of this study was to understand the demand for elderly care services and the

anticipated living arrangements among the oldest-old in China, based on an adapted framework of Andersen's behavior model, thereby providing a reference for building a sound healthcare system.

The need for care services

From the comparative analysis of the demand and supply of aged care services for the oldest-old, it can be seen that the demand is far greater than the supply. And the supply of various care services based in the community needs improvement. There were gaps in universal health coverage and increasing funding for the healthcare system before reforming the delivery system could lead to more inefficiencies [17]. Thus, it is a problem that must be solved to improve the balance between demand and supply and meet the multi-level and diversified pension needs of the oldest-old to promote further development of aged care services. Furthermore, the results showed that the demand for aged care services for the oldest-old is influenced by predisposing factors, enabling factors, and need factors.

Predisposing factors

Age and residence have a significant impact on the demand for elderly care services. The older people in the 80-89 age group have higher demand for social recreational activities than those over the age of 90, mainly due to differences in physical fitness and enthusiasm of social participation. While those aged over 100 were more willing to enjoy daily care services, they may become universally frail with increasing age. With advancing age, health status and needs of adults may change due to age-related functional impairments. The oldest-old individuals aged 100 and over have survived because of improvements in medical care and increased longevity but they may be in relatively poor health, which is described by the term "costs of success" [15]. In rural areas, where medical technology may not be as advanced, transportation is underdeveloped, and medical resources are unevenly distributed and therefore less accessible, the oldest-old have a greater need for home visit services than those living in urban areas. The health status of the oldest-old living in remote rural areas is poorer as their access to healthcare services is often limited. Conversely, urban residents with formal employment education enjoy relatively advanced medical resources [5]. Therefore, it is necessary to improve rural infrastructure, such as facilities, traffic, and medical and health systems, to enable access to elderly care services in rural areas. Furthermore, it is crucial to address the imbalance of supply and demand between rural and urban areas. Accessibility for the elderly on public transit – an important aspect of the community environment – may facilitate access for individuals living in low-supply areas by enabling travel to other service areas [18].

Enabling factors

Living arrangements and economic status have a significant impact on the demand for elderly care services. Compared to those who co-reside with children, the oldest-old living alone or living in a nursing home are more willing to engage in eight types of aged care services. The reason may be that the oldest-old who lack family care and emotional support, require aged care services to meet their physical and mental needs. Living alone does not adversely influence survival if the individual receives support from family and friends [19]. Meanwhile, the oldest-old with more difficult economic circumstances have greater demand for daily care services, which may be related to the lack of basic health services and health insurance. However, New Cooperative Medical Scheme (NCMS) did not increase utilization of outpatient and inpatient services for the following reasons: the deductibles are generally high; the enrollees do not get reimbursement immediately or is very difficult to get reimbursed if the enrollees use health facilities in other counties or cities [20]. Therefore, to improve healthcare utilization of the disadvantaged who cannot afford health insurance, health insurance programs need to provide a specific policy intervention, such as reducing deductibles [21] and coinsurance rates or offering immediate reimbursement instead of later reimbursement. The oldest-old with economic difficulties may have lower utilization and awareness rates of community services, which demonstrates a need for the government and society to give more attention and emphasis on health education.

Need factors

Self-rated health, feeling lonely and isolated, and ADL have a significant impact on the demand for elderly care services. The oldest-old with poor self-rated health have a higher demand for daily care services, home visits, daily shopping, and health education, in line with the conclusion that additional services are needed for the oldest-old whose self-rated health is fair or poor [22]. Compared to the oldest-old who often or always feel lonely and isolated, those who seldom or never feel lonely and isolated were more inclined to engage in social and recreational activities and use legal aid services, suggesting that they may be more busy socializing and in relatively good physical condition. This is in accordance with the notion that a stable social network is the key factor for preventing loneliness in the oldest-old despite their age-related limitations, particularly for those who live alone [23]. The elderly who sometimes feel lonely and isolated have a higher demand for old-age services, such as daily care, home visits, and psychological consulting, indicating that mental characteristics are positively related to health status, and play an important role in the demand for elderly care services. Therefore, when providing community-based care services, it is important to be attentive to the mental health of the oldest-old. The oldest-old whose ADL were not limited had a higher demand for social and recreation activities, health education, and neighboring relations than those with highly limited ADL. This may be because the oldest-old without limitation of ADL are more willing to participate in social activities, have a stronger sense of health, and are in better physical condition. For the oldest-old with constrained ADL, the community-based pension service should adopt the “walk in” approach, as an initiative to provide basic daily care for that group. Lower quality of life is experienced in older people with ADL-disability irrespective of living situation, whether at home or in residential care [24]. Therefore, in addition to informal care, it is also necessary to provide formal care for the oldest-old who are limited in ADL. When persons were disabled in two or more ADL-activities, the amount of formal care was greater than the amount of informal care, mainly due to help with ADL [25].

In summary, we found that the needs of the oldest-old are diverse, involving daily care, home visits, psychological consulting, daily shopping, social entertainment, legal aid, health education, and neighboring relations by analyzing the needs of elderly care services for the oldest-old in the CLHLS data in 2014. The demand for aged care services for the oldest-old was affected by residence, age, years of education, living arrangements, housing property rights, wealth, self-reported health, loneliness, and ADL. Enormous social changes, such as migration to rapidly growing urban areas, the one-child policy, and variable access to health care, would have affected the health of China’s oldest-old [26]. In order to meet the multi-level and diversified health care service needs of the oldest-old and promote the equilibrium of basic old-age services, we offer some specific suggestions. First and foremost, driven by demand expression, communities should enrich the content of old-age services, and increase the high-demand old-age services, such as home visits, health education, and spiritual comfort. Second, targeted services should be provided for the oldest-old with different age groups, places of residence, and education level. Third, a sound healthcare system based on home-community-institutions needs to be built by joint forces to optimize the balance between supply and demand of aged care services. Furthermore, the management of service quality should be highlighted, to promote the informationization and refinement of the community pension service and continuously improve the service level and the satisfaction of the oldest-old who receive community pension services.

Anticipated living arrangements

This study shows that the most common way of living for the oldest-old is to live with their children (44.4% in urban, 55.6% in rural), which is closely related to the traditional concept of nurturing children and preventing old age, consistent with the results of previous studies. In addition, some choose (45.4% in urban, 54.6% in rural) to live alone, rather than living with their children, indicating that the traditional concept of home-based care for the oldest-old has undergone subtle changes. We observed that the anticipated living arrangements for the oldest-old is significantly different depending on predisposing factors, enabling factors, and need factors.

Predisposing factors

Age has a significant impact on the living arrangements of the oldest-old. Compared with people aged 80-89, those aged 100 or older were more likely to live with their children or in LTC institutions and were reluctant to live alone. Here are some possible explanations. First, the older people who aged 100 or older are more vulnerable to poor perceived health and chronic diseases [27], which requires daily care provided by their children or professional nursing staffs. Then, when health deteriorates, functional

loss increases the rate of depression [28], and declining memory that could be a psychological barrier to greater longevity and maintaining good health. Chronic diseases can affect the brain and mind, aside from disability, these disorders are very likely to lead to dependency on caregivers, presenting stressful, complex, and long-term challenges [29]. Therefore, projects to prevent chronic disease among the oldest-old through personalized health interventions need to be prioritized and avoiding solitude could prevent psychological problems and promote social emotional support.

Enabling factors

Housing properties and the number of children have a significant impact on the living arrangements of the oldest-old . For housing property rights, the oldest-old who do not own or rent a house tended to live in nursing homes. A plausible explanation could be that the oldest-old without a stable place to live lack a certain economic basis and therefore live in LTC institutions to reduce the burden on their children and family. Housing properties reflect the economic level of the oldest-old. The socioeconomic-related inequalities can influence living arrangements, health seeking behaviors, access to health care, as well as self-reported health of the elderly, so certain programs and policies can be implemented in the health sector to address these disparities [30]. Compared to the oldest-old with three or more children, those without children were more likely to live in a nursing home. This may be because childless oldest-old are in a predicament with no one to rely on and are less likely to be reached by service providers, requiring assistance from society. It has been suggested that intergenerational support counteracts the negative association between living arrangements and old-age psychological health [31]. Chinese older adults were still very active in providing support to family members and highlighted the beneficial effects of contributory behaviors (i.e., providing their children with economic support, housework, emotional support, and grandchild care) on life satisfaction [32]. Thus, when designing new elderly care programs, the importance of family ties and support to older adults should be considered by policy makers.

Need factors

ADL may have a significant effect on the living arrangements of the oldest-old. Compared to the oldest-old with ADL that are not subject to health restrictions, those with highly restricted ADL were reluctant to live alone. There is evidence that deterioration in ADL is a sign of intellectual disability or may be associated with other age-related medical conditions [13]. With ADL limitations, oldest-old people have more difficulties with bathing, eating, dressing, walking across a room, and getting in and out of bed, requiring help from others. The poorer the health status of the elderly, the more likely they are to live with their children, particularly if they have daughters [33]. We recommend developing intervention programs aimed at improving ADL among the oldest-old as being physically active can be a protective factor for ADL-disability. In addition, assistive devices should be provided as device use may increasingly become a viable option to bridge deficits in functioning even at very old ages [2].

In summary, by analyzing the anticipated living arrangements of the oldest-old, we observed that living with children is still the most common way of providing for the oldest-old. Residential care services remain a major service provision for older people, and family plays an essential role in the healthcare of the oldest-old. However, the Chinese population is aging rapidly, especially the oldest-old, and the changes in the family structure of “Four-Two-Ones” means that children cannot effectively balance family and work time; the traditional pension model can no longer meet the needs of the elderly, especially of the oldest-old. This situation calls for actions for policy change. Caregivers’ resources under the universal two-child policy will be substantially better than that under the rigorous unchanged fertility policy [4]. It is crucial to build a pension service system with shared contributions from national security [34], government leadership, and community implementation to family response. Constructing a comprehensive pension service system based on home-community-institution can play an increasingly important role in alleviating the burden on the state, making up for the shortage of traditional family pensions, and optimizing the allocations to solve the imbalance problem between supply and demand of elderly care services.

Conclusion

With a rapid ageing population in China, various challenges have been posed regarding the existing healthcare system. Previous research has only studied the living arrangements of the Chinese elderly. This has raised concerns regarding the demand for elderly care services and anticipated living arrangements among the Chinese oldest-old, and therefore we further explored these issues and the influencing factors based on the Andersen model. We showed that there is a huge imbalance between supply and demand for the aged care services among the oldest-old. We found that the demand for aged care services and anticipated living arrangements among the oldest-old are influenced predisposing factors, enabling factors and need factors. The diversified demands for healthcare services and residence intentions among the rapidly growing population of oldest-old individuals demonstrates the crucial need to build a sound care system based on home-community-institutions. There are clear policy implications for health systems and social care systems in promoting the equilibrium of basic old-age services, not only in China but also globally. Greater shared efforts ought to be devoted to the healthcare system to meet the requirements for various elderly care services and living arrangements, and ultimately improve the quality of life of the oldest-old.

Abbreviations

CLHLS: Chinese Longitudinal Health Longevity Survey; LTC: Long-term care; QoL: Quality of life; HRQoL: Health-related quality of life; ADL: Activities of daily living

Declarations

Ethics approval and consent to participate

The dataset used in this study is a publicly available dataset. Not applicable.

Consent for publication

Not applicable.

Availability of data and material

The CLHLS dataset is publicly available. Information about the data source and available data are found at <https://www.icpsr.umich.edu/icpsrweb/DSDR/studies/>. Researchers can obtain these data after submitting a data use agreement to the CLHLS team.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

YF conceived and designed the study, supervised the data analysis; SQ, CXL wrote the paper; SQ, CXL performed all statistical analyses and YBZ contributed to revising the paper. All the authors approved the final version for submission.

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Tables

Table.1 The descriptive characteristics of the study sample

Independent Variables	Classification	N (%)
Age(years)	80~89	2207(46.6)
	90~99	1654(34.9)
	≥100	977(18.5)
Gender	Male	1957(41.3)
	Female	2781(58.7)
Residence	Urban	2074(43.8)
	Rural	2664(56.2)
Years of schooling	0	3192(67.4)
	1~6	1224(25.8)
	≥7	322(6.8)
Living arrangement	Family	3621(76.4)
	Living alone	957(20.2)
	Nursing home	160(3.4)

Table.2 The anticipated living arrangement by age cohort and residence

Dependent Variables	N (%)	Age (%)			Residence (%)	
		Aged 80-89	Aged 90-99	Aged 100+	Urban	Rural
living alone or with spouse regardless of how far away your children live	423	294(14.4)	95(6.6)	34(4.8)	192(45.4%)	231(54.6%)
living alone or with spouse with children living nearby	2267	706(34.5)	335(23.3)	126(17.9)	501(42.9%)	666(57.1%)
co-residence with children	2492	1002(49.0)	964(66.9)	526(74.8)	1106(44.4%)	1386(55.6%)
in a LTC institution	107	44(2.2)	46(3.2)	17(2.4)	60(56.1%)	47(43.9%)

Note: N=4189.

Table.3 The care service demand for the oldest old (logistic regression)

Independent Variables	Daily care		Home visit		Psychological consulting		Daily shopping		Social and recreation activities		Legal aid		Health education		Neighboring relations	
	B	OR	B	OR	B	OR	B	OR	B	OR	B	OR	B	OR	B	OR
Predisposing factors																
Age (Ref. aged 80-89)																
Aged 90-99	0.080	1.083	0.058	1.060	0.072	1.074	-0.008	0.992	-0.141	0.869*	-0.100	0.905	-0.017	0.983	-0.118	0.888
Aged 100	0.179	1.196*	0.093	1.098	0.111	1.117	0.057	1.059	-0.209	0.812*	-0.037	0.964	0.058	1.060	-0.170	0.844
Residence (Ref. urban)																
Rural	0.027	0.973	0.363	1.437***	-0.060	0.941	0.049	1.050	-0.074	0.929	-0.066	0.936	0.003	1.003	-0.039	0.962
Years of schooling (Ref. 0)																
1-6	0.022	0.978	-0.174	0.840	-0.012	0.988	0.047	1.048	0.031	1.031	0.025	1.026	0.015	1.015	-0.103	0.902
≥7	0.096	0.909	-0.512	0.599***	-0.117	0.889	-0.111	0.895	-0.199	0.819	-0.183	0.833	-0.278	0.758	-0.340	0.712*
Enabling factors																
Living arrangement (Ref. family)																
living alone	0.360	1.434***	0.245	1.278*	0.438	1.549***	0.340	1.405***	0.302	1.353***	0.281	1.324***	0.309	1.362***	0.270	1.309***
Nursing home	1.439	4.216***	0.577	1.178*	1.406	4.081***	1.265	3.542***	1.181	3.259***	1.141	3.129***	0.841	2.318***	1.076	2.933***
Housing property rights (Ref. owned)																
Rented	0.163	0.850	-0.238	0.788	-0.134	0.874	-0.309	0.734	-0.120	0.887	-0.369	0.692*	-0.228	0.796	-0.301	0.740
Others	0.220	0.802	-0.519	0.595**	-0.241	0.786	-0.270	0.763	-0.202	0.817	-0.311	0.733	-0.685	0.504***	-0.357	0.700*
Economic status (Ref. poor)																
fair	0.186	0.830	-0.103	0.902	0.043	1.044	-0.110	0.896	0.175	1.192	0.082	1.086	-0.040	0.961	0.041	1.042
rich	0.367	0.692**	-0.248	0.781	-0.039	0.962	-0.217	0.805	0.132	1.141	-0.012	0.988	0.102	1.108	-0.041	0.960
Need factors																
Self-reported health (Ref. bad)																
fair	0.181	0.834	-0.078	0.925	-0.105	0.900	-0.062	0.940	-0.068	0.934	-0.024	0.976	-0.094	0.910	0.030	1.030
good	0.340	0.712***	-0.306	0.737*	-0.235	0.791*	-0.258	0.772*	-0.250	0.779*	-0.160	0.852	-0.256	0.774*	-0.217	0.805*
Feel lonely and isolated (Ref. always/often)																
Sometimes	0.328	1.389**	0.331	1.393*	0.467	1.596***	-0.062	0.940*	0.487	1.628***	0.434	1.543***	0.421	1.523**	0.240	1.271

Seldom/never	0.079	1.083	0.268	1.307	0.132	1.141	0.144	1.155	0.298	1.347*	0.244	1.277*	0.183	1.201	0.020	1.020
ADL (Ref: strongly limited)																
limited	0.147	1.159	0.202	1.223	0.113	1.119	0.140	1.150	0.132	1.141	0.097	1.102	0.134	1.143	0.137	1.147
no limited	0.134	1.143	0.175	1.192	0.119	1.126	0.212	1.236	0.272	1.313**	0.183	1.201	0.353	1.423***	0.320	1.377***

Note: N=4738. Multiple logistic regression was adopted. * P<0.05, ** P<0.01, *** P<0.001, *B* represents partial regression coefficient.

Table.4 The anticipated living arrangement for the oldest old (logistic regression)

Independent Variables	living alone or with spouse with children living nearby		co-residence with children		in a LTC institution	
	<i>B</i>	<i>OR</i>	<i>B</i>	<i>OR</i>	<i>B</i>	<i>OR</i>
Predisposing factors						
Age (Ref. aged ≥100)						
Aged 90-99	-0.243	0.784	-0.160	0.852	0.218	1.244
Aged 80-89	0.083	1.086	-1.168	0.311***	-1.041	0.353*
Gender (Ref. female)						
	0.195	1.215	-0.644	0.904***	-0.182	0.833
Residence (Ref. Rural)						
urban	0.028	1.028	-0.062	0.940	-0.064	0.938
Years of schooling (Ref. ≥7)						
1-6	0.302	1.353	0.156	1.169	0.575	1.777
0	0.449	1.567*	0.410	1.506*	0.526	1.693
Enabling factors						
Housing property rights (Ref. others)						
rented	0.160	1.174	0.319	1.376	-3.252	0.039***
owned	-0.186	0.831	-0.308	0.735	-3.623	0.027***
Number of children (Ref. ≥3)						
1-2	-0.598	0.550	-0.353	0.703	0.420	1.522
0	-0.282	0.754	-0.072	0.931	2.332	10.297***
Economic status (Ref. rich)						
fair	-0.318	0.727	-0.407	0.666	0.419	1.521
poor	-0.074	0.929	-0.309	0.734*	-0.265	0.767
Need factors						
Self-reported health (Ref. good)						
Fair	-0.165	0.848	0.148	1.159	0.294	1.342
Bad	0.134	1.143	0.142	1.152	0.131	1.139
Feel lonely and isolated (Ref. Seldom/never)						
Sometimes	0.324	1.382*	0.149	1.161	0.350	1.420
always/often	-0.063	0.939	-0.057	0.945	0.485	1.623
ADL (Ref. no limited)						
Limited	0.211	1.235	0.234	1.264	0.489	1.631
strongly limited	0.682	1.978**	0.918	2.503***	0.983	2.673*

Note: N=4189. Taking "living alone or with spouse regardless of how far away your children live" as reference, Logistic regression analyses were performed. * P<0.05, ** P<0.01, *** P<0.001 (two-sided)

Figures

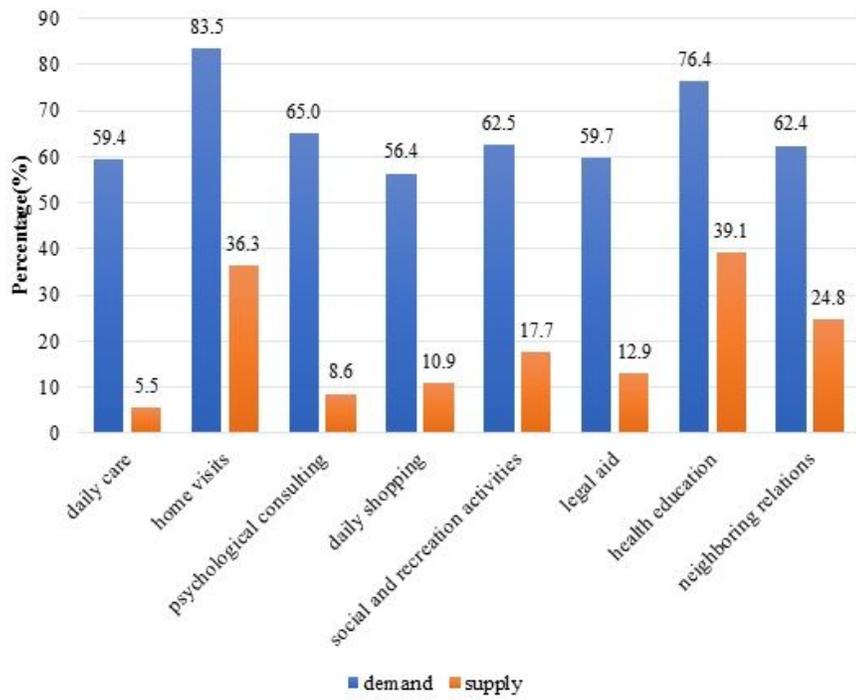


Figure 1

The demand and supply of various aged care services for the oldest old