

RESEARCH

Open Access



Inequity in the utilization of the home and community integrated healthcare and daily care services in older adults with limited mobility in China

Siyu Cai¹, Qixiao Pei², Xuanxuan Wang^{1,3*} and Dongfu Qian^{1,3*}

Abstract

Background This study aimed to analyze the needs and utilization of the home and community integrated health-care and daily care services (“home and community care services” for short) among older adults in China and to investigate the inequity in services utilization.

Methods Cross-sectional data were obtained from the 2018 China Health and Retirement Longitudinal Study. Needs and utilization rates of the home and community care services in older adults of 60 years old and above were analyzed. Binary logistic regression analysis was performed to explore the factors associated with services utilization among older adults with limited mobility. Concentration index, horizontal inequity index, and Theil index were used to analyze inequity in services utilization. Decomposition analyses of inequity indices were conducted to explain the contribution of different factors to the observed inequity.

Results About 32.6% of older adults aged 60 years old and above had limited mobility in China in 2018, but only 18.5% of them used the home and community care services. Among the single service utilization, the highest using rate (15.5%) was from regular physical examination. Limited mobility, age group, income level, region, self-assessed health, and depression were statistically significant factors associated with utilization of any one type of the services. Concentration indices of any one type service utilization and regular physical examination utilization were both above 0.1, and the contribution of income to inequity were both over 60%. Intra-regional factor contributed to about 90% inequity of utilizing any one type service, regular physical examination and onsite visit.

Conclusions This current study showed that older adults with needs of home and community care services underused the services. Pro-rich inequities in services utilization were identified and income was the largest source of inequity. The difference of the home and community care service utilization was great among provinces but minor across regions. Policies to optimize resources allocation related to the home and community care services are needed to better satisfy the needs of older adults with limited mobility, especially in the low-income group and the central region.

*Correspondence:

Xuanxuan Wang
annawang@njmu.edu.cn
Dongfu Qian
dqian@njmu.edu.cn

Full list of author information is available at the end of the article



© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

Keywords Integrated healthcare, Home and community, Inequity, Older adults, Limited mobility, Service need, Service utilization, China

Introduction

While aging population is a global trend, China has the largest older adults population in the world, and will encounter a more rapid aging rate in the coming decade [1, 2]. The proportion of older adults population aged 65 years old and above in China is projected to be 28.9% in 2049 [3]. Compared with the young and middle-aged population, older residents have higher risk of being disabled or partially disabled, which will lead to difficulty in moving around [3, 4]. As to the traditional family concept, older adults in China are inclined to be cared by family members, especially their offspring [5]. But attributed to the One-Child Policy and the fast pace of urbanization, older adults are now facing “empty nest” – living alone with the outmigration of adult children [5–7]. Under such circumstance, the needs for basic health services and daily care provided at home and in the community for the aged are becoming increasingly strong.

In November 2015, the General Office of China’s State Council issued the *Guidelines on Promoting the Integration of Healthcare and Older Care Services* (“Guidelines” for short), which clearly stated that along with older care services provided in the community, health services such as regular physical examinations, home visits, family beds, community nursing and health management should be provided for older residents who have limited mobility, i.e. the ones who are disabled or partially disabled. The home and community integrated healthcare and daily care services for older adults (“the home and community care services” for short) was proposed thereafter. At the end of 2020, the home and community care services were piloted in 203 cities in five batches.

Studies on the home and community care services mainly focus on the implementation effects. Researchers found that the home and community care services had significant effect on improving life satisfaction, life quality, physical and mental health status, and health care utilization [8, 9]. Other studies look into the demand of the home and community care services by asking older residents whether they were willing to use the services [10, 11]. However, service demand and need are two separate concepts with distinct definitions. Partly due to difficulty in data collection, few studies examine the actual needs of the home and community care services. Up till now, there has been limited information on how large the chasm is between services needs and services utilization.

Equity in health service utilization has always been the concern of researchers and policy-makers worldwide.

Previous study on inequalities in health service utilization among older adults are mainly confined to emergency service, outpatient and inpatient service [12–14]. It has been proved that socioeconomic status factors such as occupation type, income level, education level, and with or without medical insurance, demographic factors such as age and gender, and health need factors such as chronic diseases and limited mobility are correlated to inequity in health care utilization among older adults [15–20]. Long-term care services, which have some intersection with the home and community care services, have been studied from various perspectives. However, research on equity in long-term care did not provide a consensual result. Studies found pro-rich inequity in long-term care service utilization in Spain, Italy and Germany, while the result was opposite in Denmark, Netherlands, and France [21, 22]. Studies conducted in China suggested that long-term care services reduced the inequity level of limited mobility, serious diseases, outpatient and inpatient reimbursement [23]. A study using the level of occupancy, and rehabilitation and nursing services utilization rate to assess inequity in long-term care service utilization showed that there was a pro-rich inequity in both urban and rural China [24]. There are relatively few studies on the inequity in the home and community care services in China from the level of individual service utilization. It is unknown whether the home and community care services utilization is equitably distributed among older adults with limited mobility.

This current study aimed to analyze the utilization of the home and community integrated healthcare and daily care services for older adults with limited mobility in China, and to identify the inequity in the services utilization.

Methods

Study design

This current study has a cross-sectional design. Data were drawn from the China Health and Retirement Longitudinal Study (CHARLS) wave 4 in 2018 [25]. Starting from 2011, CHARLS is a longitudinal survey with a nationally representative sample of people aged 45 years and above. Data in wave 4, 2018 were collected from 449 villages/communities in 28 provinces/municipalities. The investigators obtained response from 19,816 individuals in 11,635 households. As this current study analyzed the home and community care

services for older adults with limited mobility, respondents younger than 60 years old, living in nursing institutions or hospitals, and not suffering from limited mobility were excluded. Respondents who did not answer the question of the home and community care services were then excluded. Consequently, a total of 2783 individuals were included in the analysis. Figure 1 showed the process of participants exclusion.

Measures

Home and community care services needs

In accordance with the *Guidelines*, older adults with limited mobility, i.e. the ones who are disabled or partially disabled have needs for the home and community care services. In this current study, limited mobility was measured by activities of daily living (ADL) with the Physical Self-Maintenance Scale (PSMS). PSMS contains six items, which are dressing, bathing, eating, getting into or out of bed, using the toilet, and controlling urination and defecation, and each has answering options of “no difficulty,” “difficult but can still be done,” “have difficulties and need help,” and “unable to complete.” If the respondent selected an option other than “no difficulty” for any one item, the respondent was classified as having limited mobility and having needs for home and community care services [26]. According to the standards proposed by the China Scientific Research Center on Aging, respondents reporting difficulty in one to two, three to four and five and above items were classified into the mild, moderate, and severe group, respectively [27, 28].

Home and community care services utilization

Utilization of the home and community care services was measured based on answers to the question – “Have you ever received the following home and community care services?” The answering options consist of 1) older adults day care, 2) regular physical examination, 3) onsite visit, 4) family bed, 5) community nursing, 6) health management and 7) entertainment. If the respondent answered “yes” to any one of the options, it

is considered that the respondent had used the home and community care services.

Factors associated with home and community care services utilization

This current study followed the prevailing literature in selecting factors associated with health services utilization for older adults [29, 30]. Besides service needs, i.e. limited mobility measured by ADL, and given the data collected in CHARLS wave 4, factors included into analysis were age group, gender, marital status, income level quintile, education level, region, urban/rural, medical insurance, self-assessed health, depression, and chronic disease number. Age was categorized into three groups, including 60–69, 70–79, 80+ years. Gender included male and female. Marital status was classified into married, single/separated/divorced, and widowed. Education level included two groups: no formal education and primary school and higher. Self-assessed health status was divided into very good, good, fair, poor, or very poor [31].

Income level According to the Six and Seventh National Census Bulletin from National Bureau of Statistics (NBS) of China, the main sources of livelihood of older population were family support, labor income, pension, and income transfers [32]. The income was a continuous variable, calculated as the sum of family support (income from other household), labor income (income from employment, agriculture, and self-employment), pension, and income from transfers. The natural logarithm value of the income was used and further divided respondents into five groups from poorest to richest [16].

Medical insurance China’s Basic medical insurance system consisted of the Urban Employee Basic Medical Insurance (UEBMI), the Urban Resident Basic Medical Insurance (URBMI), and the New Cooperative Medical Scheme (NCMS) for rural residents [33]. In 2016, the Urban and Rural Resident Basic Medical Insurance (URRBMI) was established to merge NCMS and URBMI officially [34]. Therefore, in addition to the three basic medical insurance, there was also URRBMI in the investigation stage of this study in 2018. The medical insurance in this study was divided into 6 categories: no insurance, UEBMI, URRBMI, URBMI, NCMS, and others.

Region CHARLS covered 28 provinces in China. According to the China Health Statistics Yearbook, 10 out of 28 surveyed provinces were classified into the western region, 8 provinces were in the central region, and the left 10 provinces were in the eastern region.

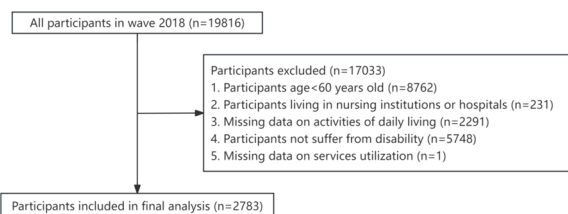


Fig. 1 Flowchart on the participants exclusion process

Depression Depression was measured by the Center for Epidemiological Studies Depression Scale (CESD-10) [35], including two positive emotion items, five somatic symptom items, and three depressed emotion items. Respondents responded based on their feelings and behaviors last week. For each item, there are four answering options, i.e., 0=little or no (<1 day), 1=not too much (1–2 days), 2=sometimes or half the time (3–4 days), 3=most of the time (5–7 days). The option scores for the items were added up and the two positive emotion items used reversed scoring. Respondents were divided into three groups –no depressive symptoms (a CESD-10 score <10), depressive symptoms (10 ≤ score <20), and depression (score ≥ 20) [36].

Chronic disease number Fourteen specified chronic diseases including hypertension, dyslipidemia, diabetes, heart disease, stroke, chronic lung disease, asthma, liver disease, cancer, digestive disease, kidney disease, arthritis, psychiatric disease, and memory-related disease were confirmed by participant’s self-report of a physician’s diagnosis [37]. According to definition of multiple chronic diseases, the classifications of chronic disease number included no chronic diseases, 1 chronic disease, and 2 or more chronic diseases [38].

Statistical analyses

In order to analyze inequity in the utilization of home and community care services in China, a multi-stage approach was followed in Fig. 2. In the first stage, the needs of home and community integrated healthcare and daily care services were analyzed. In the second stage, the chi-square test was used to describe disparities in service utilization between the mild, moderate, and severe

limited mobility group. Binary logistic regression was used to evaluate the effect size and direction of different characteristics on the utilization of home and community care services. The results of logistic regression showed that income level and region were associated with home and community care services utilization. Therefore, in the third stage, concentration index (CI) and horizontal inequity index (HI) were used to measure the inequity in the distribution of home and community care services utilization across older adults with limited mobility. Theil index (TI) was applied to measure inequity in different regions among older adults who utilized home and community care services.

Concentration index

CI was used to measure the extent of socioeconomic-related inequity in the distribution of home and community care services utilization across older adults with limited mobility [39, 40]. CI was calculated with reference to the concentration curve, which plotted the services utilization variable in the y-axis against the percentage distribution ranked by wealth measure in the x-axis. This current study used income level as a proxy variable for wealth measure. The CI equation was as follows:

$$C = \frac{2}{\mu} \text{cov}(h, r)$$

where *h* represents the home and community care services utilization, *μ* is its mean, and *r* is the fractional rank of individual in the wealth measure distribution. Individual wealth was reflected by the income level, which was calculated from four parts – family support, labor income, pension, and income transfers.

Given that all the outcome variables were binary variables, the least squares regression method of indirect

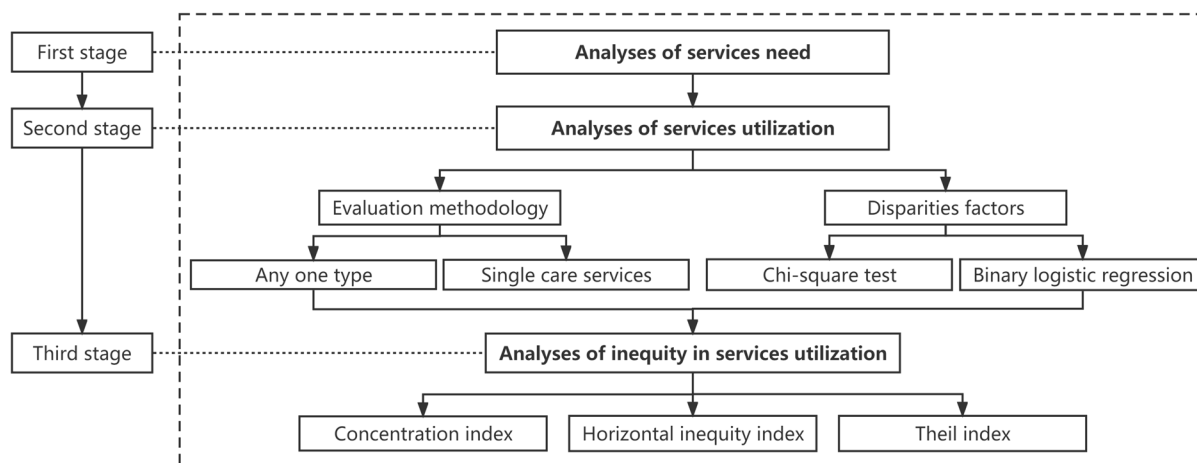


Fig. 2 Flowchart on the analyses process

standardization would not guarantee the predicted values from the standardizing regression, the equation expressed as follows [41]:

$$y_i = G(\alpha + \sum_j \beta_j x_{ji} + \sum_k \gamma_k z_{ki}) + \varepsilon_i$$

where G represents the functional form for a nonlinear model using a Probit model, x_j and z_k represent the demographic characteristics/health status and socioeconomic variables respectively.

Linear approximation method to the nonlinear model was applied to decomposing CI, which was evaluated at the means to use estimates of the partial effects. A linear approximation was presented as follows:

$$y_i = \alpha^m + \sum_j \beta_j^m x_{ji} + \sum_k \gamma_k^m z_{ki} + u_i$$

where β_j^m and γ_k^m are used to replace β_j and γ_k for representing the partial effects of x and z , i.e. the determinants of y , and u_i is the implied error term, which includes approximation errors.

The CI-based HI approach was applied to quantify the inequity of home and community care services utilization. HI was measured as the variation in services utilization by rank of income level after adjusting for differences in variables such as demographic characteristics and health status [42]. Next, we conducted a decomposition of CI. The contributions of socioeconomic variables in total inequality explain actual inequities in home and community care services, as socioeconomic-related inequity is deemed unjustified or unfair [43]. If the contribution of a variable was positive, it indicated that the variable promoted pro-rich inequity.

For binary outcome variable, the number of respondents for the option less selected needed to be at least 10 times greater than the number of independent variables to use [44]. Since CI-relevant analyses included constructing the Probit model, certain home and community care services with rather low utilization rate were excluded from CI-relevant analyses.

Theil index

TI was used to measure the inequity of the home and community care services utilization in different regions and provinces. TI takes a value ranging from 0 to $\log n$, and it expresses highly equity when TI approaches 0 [45]. The equation below is adopted to calculate the value of total TI:

$$T = \sum_{i=1}^n Y_i \log \frac{Y_i}{P_i}$$

where Y_i represents the ratio of number of respondents using home and community care services in different

provinces to those in corresponding regions and P_i is the ratio of number of respondents in different provinces to those in corresponding regions. Therefore, TI was decomposed into two levels (T_{intra} and T_{inter}) [46] as follows:

$$T_{total} = T_{inter} + T_{intra} = \sum_{i=1}^n Y_i \log \frac{Y_i}{P_i} + \sum_{i=1}^n Y_i T_i$$

where T_i is the value of TI of three regions, including the eastern, central, and western region. T_{intra} is the intraregional distribution of services utilization in the three regions, and T_{inter} means interregional distribution among different regions [47]. Accordingly, we calculated the contribution of TI for different regions to analyze the source of inequity. The equations are as follows:

$$contribution_{intra} = T_{intra} / T$$

$$contribution_{inter} = T_{inter} / T$$

$$contribution_{regioni} = Y_i T_i / T$$

Inverse probability weighting (IPW) was applied to adjusting for potential selection bias. In the first step, analytical weights were produced by estimating the included probability for each individual with complete data on ADL items via binary logistic regression. In the regression analysis, the dependent variable was completeness of ADL items, where complete data were valued as 1 and incomplete ones were valued as 0. Weights were calculated as the inverse of the probabilities. The variables used to estimate weights were the same as those in the original binary logistic regression analysis of the utilization of home and community care services. Standardized mean differences (SMD) were used to assess differences in general characteristics between participants included and excluded due to missing values on ADL items [48]. In the second step, differences in the results of binary logistic regression analyses of service utilization between the original unweighted and the inverse probability-weighted samples were examined to verify the robustness of this current study. Due to missing values on covariates, samples with complete data on covariates and samples applying multiple imputation for missing data on covariates were used to estimate weights, respectively [49]. As the results of binary logistic regression analyses using unweighted and weighted samples were consistent and ADL was the screening variable for service needs in this current study, participants excluding individuals with missing data on ADL items were then included into the subsequent analyses.

Descriptive analyses of general characteristics, binary logistic regression of service utilization and concentration indices were performed by using and not using

individual sample weights adjusted for non-response of individual and household, respectively. As no significant differences were found, unweighted analyses on CI decomposition and Theil indices were then carried out.

Descriptive analyses were conducted in SPSS 26.0. Inverse probability weighting and multiple imputation were conducted using R 4.2.0. All other data analyses were carried out in Stata 15.0. A two-tailed P-value below 0.05 was considered statistically significant.

Results

General characteristics

As stated in the 2018 CHARLS survey guidelines, respondents who were younger than 50 years, and concurrently reporting very good or good health, without disabilities, not troubled with body pains, and diagnosed with no chronic diseases could skip ADL items. After the research group excluded participants younger than 60 years from this current study, there were 2291 respondents having missing data on ADL items. Compared to the ones having complete data on ADL, participants who did not provide answers to ADL questions were younger, more males, having higher socioeconomic status and reporting less health problems (in Appendix Table S1). After inverse probability weighting and multiple imputation, changes in SMD showed that the differences between included and excluded participants were smaller compared with the differences between the unweighted samples (in Appendix Figure S1 and S2). The results of binary logistic regression analysis using the original unweighted samples were consistent with those using inverse probability weighting for ADL (in Appendix Table S2 and S3) and those applying multiple imputation for covariates and inverse probability weighting for ADL (in Appendix Table S4 and S5).

Among the 8532 respondents in the survey who were not living in nursing institutions or hospitals, 32.6% had mild to severe limited mobility, in other words, having needs of the home and community care services. Summary statistics of the general characteristics of older adults with limited mobility were presented in Table 1. It showed that 65.36% of older adults with needs of the home and community care services were mildly limited mobility, 81.53% were 60 to 79 years old, 60.04% were female, 69.85% were married. In term of socioeconomic status, 65.43% had no formal education, 85.88% lived in rural areas, and 68.88% participated in the medical insurance of NCMS. In respect of health status, 60.40% had at least one chronic disease, 92.53% had fair or poor self-assessed health status, and 63.49% had depressive symptoms or were assessed as patients with depression. As shown in Appendix Table S6, the unweighted analyses results of participants' general characteristics were of no

Table 1 General characteristics of older adults with limited mobility in China, 2018

Variable	Total (n = 2783)		User group (n = 516)		Utilization rate %
	N	%	N	%	
Limited mobility					
Mild	1819	65.36	348	67.44	19.13
Moderate	587	21.09	109	21.12	18.57
Severe	377	13.55	59	11.43	15.65
Demographic characteristics					
Age group (yrs)					
60–69	1284	46.14	197	38.18	15.34
70–79	985	35.39	208	40.31	21.12
80+	514	18.47	111	21.51	21.60
Gender					
Male	1112	39.96	216	41.86	19.42
Female	1671	60.04	300	58.14	17.95
Marital status					
Married	1944	69.85	345	66.86	17.75
Single/separated/divorced	60	2.16	12	2.33	20.00
Widowed	779	27.99	159	30.81	20.41
Socioeconomic status					
Income level quintile					
Poorest	558	20.05	85	16.47	15.23
2 nd poorest	553	19.87	89	17.25	16.09
Middle	560	20.12	113	21.90	20.18
2 nd richest	556	19.98	113	21.90	20.32
Richest	556	19.98	116	22.48	20.86
Education level					
No formal education	1821	65.43	340	65.89	18.67
Primary school and higher	962	34.57	176	34.11	18.30
Region					
Eastern	802	28.82	158	30.62	19.70
Central	967	34.75	141	27.33	14.58
Western	1014	36.44	217	42.05	21.40
Urban/rural					
Urban	393	14.12	76	14.73	19.34
Rural	2390	85.88	440	85.27	18.41
Medical insurance					
UEBMI	264	9.49	57	11.05	21.59
URRBMI	306	11.00	77	14.92	25.16
URBMI	113	4.06	21	4.07	18.58
NCMS	1917	68.88	336	65.12	17.53
Others	56	2.01	8	1.55	14.29
No insurance	127	4.56	17	3.29	13.39
Health status					
Self-assessed health ^a					
Very good	63	2.64	17	3.83	26.98
Good	115	4.83	24	5.41	20.87

Table 1 (continued)

Variable	Total (n = 2783)		User group (n = 516)		Utilization rate %
	N	%	N	%	
Fair	810	33.99	154	34.68	19.01
Poor	1000	41.96	167	37.61	16.70
Very poor	395	16.58	82	18.47	20.76
Depression ^a					
No depressive symptoms	662	36.51	137	38.70	20.69
Depressive symptoms	793	43.74	171	48.31	21.56
Depression	358	19.75	46	12.99	12.85
Chronic disease number					
No chronic diseases	1102	39.60	192	37.21	17.42
1 chronic disease	899	32.30	172	33.33	19.13
2 or more chronic diseases	782	28.10	152	29.46	19.44

^aThe number of observations were not equal to the number of the total sample. Observations N (%) were: self-assessed health, 2383(85.6%); depression, 1813(65.1%)

significant difference with the weighted ones using individual sample weights adjusted for non-response of individual and household in CHARLS.

Among older adults surveyed who had needs of the home and community care services, 18.5% used at least one type of such services. As shown in Table 2, in term of the utilization rate of different service type, the highest using rate was from regular physical examination, but only about 15.5%. The mild group had a statistically significantly higher utilization rate (16.7%) than the moderate (15.2%) and severe groups (10.3%). Differences in the utilization rates of the other six service types and the

rate in using any one type of such services did not vary significantly by limited mobility level. As presented in Appendix Table S7, the weighted analyses results of utilization rates were of no significant difference with the unweighted ones.

Factors associated with home and community care services utilization

As demonstrated in Table 1, among older adults with need of home and community care services, those with mild limited mobility had higher service utilization than the severe limited mobility groups. The older adults groups of higher services utilization were 80+ years old (21.60%), male (19.42%), widowed (20.41%), western region (21.40%), urban areas (19.34%), URRBMI (25.16%). In terms of health status, service utilization of old people with poor self-assessed health (16.70%) and depression (12.85%) was below average. 19.44% participants with multiple chronic diseases used the home and community care services.

Table 3 showed the results of the binary logistic regression analyses for any one type of the home and community care services utilization. After controlling variables of demographic characteristics, socioeconomic status, and health status, older adults with severe limited mobility were 0.50 times less likely to use the home and community care services than the ones with mild limited mobility. Compared with older adults aged 60–69 years and the ones from the poorest quintile, the older groups and the ones from the wealthier quintile were more likely to use any one type of the home and community care services. Older adults living in the central region were 0.57 times less likely to use the home and community care services than the ones in the western region. In term of self-assessed health, older adults reporting fair and poor health

Table 2 Utilization rates of the home and community care services

Service type	Total sample (n = 2783)		Mild (n = 1819)		Moderate (n = 587)		Severe (n = 377)		P-value [†]
	N	%	N	%	N	%	N	%	
Any one type	516	18.54	348	19.13	109	18.57	59	15.65	0.286
Regular physical examination	431	15.49	303	16.66	89	15.16	39	10.34	0.008**
Onsite visit	117	4.20	67	3.68	26	4.43	24	6.37	0.059
Family bed	6	0.22	3	0.16	2	0.34	1	0.27	0.709
Community nursing	13	0.47	6	0.33	4	0.68	3	0.80	0.334
Health management	45	1.62	31	1.70	8	1.36	6	1.59	0.849
Older adults day care	8	0.29	4	0.22	2	0.34	2	0.53	0.570
Entertainment	8	0.29	4	0.22	2	0.34	2	0.53	0.570

[†]P value for Pearson chi square test comparing individuals with mild to severe limited mobility

** Statistical significance at 1% level

Table 3 Binary logistic regression analyses of the home and community care services utilization

Variables	Categories	β	OR	SE	P-value	95% Confidence Interval	
						Lower	Upper
Limited mobility	Mild (Ref)						
	Moderate	-0.270	0.763	0.167	0.106	0.550	1.059
	Severe	-0.692	0.500	0.279	0.013*	0.289	0.865
Age group (yrs)	60–69 (Ref)						
	70–79	0.438	1.549	0.134	0.001**	1.190	2.017
	80+	0.547	1.728	0.214	0.011*	1.136	2.629
Gender	Male (Ref)						
	Female	-0.146	0.864	0.135	0.279	0.663	1.126
Marital status	Married (Ref)						
	Single/separated/divorced	0.241	1.272	0.398	0.546	0.583	2.776
	Widowed	0.098	1.103	0.155	0.526	0.814	1.495
Income level quintile	Poorest (Ref)						
	2nd poorest	-0.139	0.870	0.229	0.544	0.555	1.364
	Middle	0.312	1.366	0.207	0.132	0.911	2.050
	2nd richest	0.584	1.794	0.206	0.005**	1.198	2.685
	Richest	0.370	1.447	0.225	0.100	0.931	2.248
Education level	No formal education (Ref)						
	Primary school and higher	-0.023	0.978	0.138	0.869	0.746	1.281
Region	Western (Ref)						
	Eastern	-0.280	0.756	0.152	0.065	0.562	1.017
	Central	-0.558	0.573	0.147	< 0.001**	0.429	0.764
Urban/rural	Urban (Ref)						
	Rural	-0.034	0.967	0.204	0.869	0.648	1.442
Medical insurance	No insurance (Ref)						
	UEBMI	0.172	1.188	0.399	0.666	0.543	2.599
	URRBMI	0.204	1.226	0.364	0.576	0.601	2.502
	URBBI	0.280	1.323	0.441	0.526	0.558	3.137
	NCMS	0.112	1.118	0.330	0.735	0.586	2.135
	Others	-0.017	0.983	0.606	0.977	0.300	3.226
Self-assessed health	Very good (Ref)						
	Good	-0.191	0.826	0.413	0.644	0.367	1.857
	Fair	-0.678	0.508	0.334	0.042*	0.264	0.976
	Poor	-0.657	0.519	0.336	0.051	0.268	1.002
	Very poor	-0.376	0.687	0.358	0.294	0.340	1.387
Depression	No depressive symptoms (Ref)						
	Depressive symptoms	0.174	1.190	0.138	0.207	0.908	1.559
	Depression	-0.441	0.643	0.203	0.030*	0.432	0.958
Chronic disease number	No chronic diseases (Ref)						
	1 chronic disease	0.187	1.206	0.144	0.192	0.910	1.598
	2 or more chronic diseases	0.175	1.191	0.157	0.266	0.876	1.620

* Statistical significance at 5% level

** Statistical significance at 1% level

were 0.51 and 0.52 times less likely to use the services than the group reporting very good health, respectively. Last but not least, compared with the group without depressive symptoms, the group having depression were 0.64 times

less likely to use the home and community care services. As demonstrated in Appendix Table S8, the weighted binary logistic regression results were of no significant difference with the unweighted ones.

As shown in Appendix Table S9, limited mobility, age group, income level, region, medical insurance were associated with regular physical examination service utilization. Older adults with URRBMI were 0.93 times more likely to use regular physical examination service than the group without medical insurance. While in Appendix Table S11, participants having NCMS and depression were less likely to use onsite visit service. As demonstrated in Appendix Table S10 and Table S12, the weighted binary logistic regression results were of no significant difference with the unweighted ones.

Equity in the home and community care services utilization

Table 4 presented the results of CI to measure the inequity in the utilization of the home and community care services. Since the utilization rates of family bed, community nursing, health management, older adults day care, and entertainment were quite low, the CI values for utilizing any one type of the home and community care services, regular physical examination, and onsite visit were calculated. The results demonstrated that all the three CI values were positive. In other words, there was a consistent pro-rich inequity in using the home and community care services among older adults with limited mobility. The most unequal distribution was identified in the utilization of regular physical examination (CI=0.120), followed by the utilization of any one type of the services (CI=0.100), while there was no evidence for inequity in onsite visit utilization. HI values for utilizing any one type of the services and regular physical examination were 0.086 and 0.106, respectively. As shown in Appendix Table S13, the weighted CI analyses results were of no significant difference with the unweighted ones.

Since the CI values for any one type service utilization and regular physical examination utilization were statistically significant, CI decomposition analyses were performed correspondingly. Figure 3 showed the top three factors with the most contribution to each service decomposition of horizontal inequities. Income was the most important factor leading to inequity, with the contribution to over 60% in both the any one type service utilization

and the regular physical examination utilization. Medical insurance also contributed (18.4%) to the pro-rich inequity in utilization of regular physical examination, while only 0.2% to any one type of the services. Region made negative contributions to inequity, although with a smaller magnitude: the absolute value of contribution was less than 4% (-3.3% for any one type of the services, and -2.2% for regular physical examination). Full decomposition results of CI values were presented in Appendix Table S14-S15. According to the full decomposition results, more severe limited mobility and more serious depression conditions contributed to pro-rich inequity, which explained about 4–6% of inequities in probability of using any one type service and regular physical examination. Unobserved heterogeneities accounted for 22.9% and 7.1% of inequity in utilizing any one type service and regular physical examination, respectively.

As shown in Table 5, the inequity of the home and community care services utilization in various provinces across regions was further analyzed. The TI value of utilizing any one type service, regular physical examination and onsite visit was 0.116, 0.148 and 0.241, respectively. According to TI decomposition values, the main inequity of services utilization was from intraregional contribution (about 90%). The western region contributed the most (35.78–45.98%) to the inequity in the home and community care services utilization. There were disparities in equity of different types of services utilization in different regions. The most inequitable regions of any one type service utilization, regular physical examination utilization, and onsite visit utilization were eastern (0.108), central (0.167), and eastern (0.363), respectively.

Discussion

As found in this current study, about one-third of older adults over 60 years old had home and community care service needs, while services utilization presented obvious deficiency. Older adults with severe limited mobility, in the lower income level, having poor self-assessed health and depression, and living in the central region

Table 4 Concentration indices and horizontal inequity indices for the home and community care services utilization

Service type	CI	SE	P-value	95% Confidence Interval		HI
				Lower	Upper	
Any one type	0.100	0.027	<0.001**	0.048	0.153	0.086
Regular physical examination	0.120	0.029	<0.001**	0.062	0.178	0.106
Onsite visit	0.029	0.066	0.663	-0.101	0.159	0.004

CI Concentration index, SE Standard error, HI Horizontal inequity index

** Statistical significance at 1% level

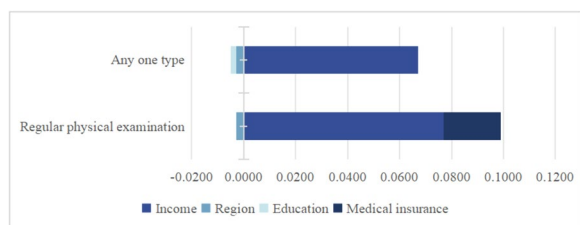


Fig. 3 Decomposition of horizontal inequities in the home and community care services utilization

were less likely to use any one type of the home and community care services. There was a pro-rich inequity in the utilization of any one type of the home and community care services and the regular physical examination. The main inequity of services utilization was from intraregional contribution.

Among older adults with needs of the home and community services, most of them were female, concentrated in 60–79 years old, had lower socioeconomic levels, and reported more health problems. The home and community care services may guarantee their right of receiving convenient and appropriate basic healthcare and daily care services timely. However, the utilization rate was only 18.5% in 2018, nearly three years after the *Guidelines* was issued though. It might be due to the fact that the home and community care services were implemented as pilot work at the city level. Before the 2018 CHARLS was conducted, the home and community care services were delivered in only 90 pilot cities across the nation. Therefore, policymakers from different government sectors such as health, civil affairs and finance should coordinate and develop systematic measures to scale up the delivery of the home and community care services. In this current study, the utilization rate of each single service was all below 4% except regular physical examination, which was in consistence with previous studies [50, 51]. Chinese government has implemented the National Basic Public Health Services Program since

2009, in which regular physical examination is a fixed item and must be provided free of charge once a year to older adults. As community nursing, family bed and onsite visit are not fixed items, primary health professionals have already had heavy workload, and the reimbursement policies on delivering such services were not uniform across pilot cities, primary health professionals may have insufficient motivation to provide the home and community care services. It was proved that home and community care had a slower development overall relative to institutional care [52].

This current study identified disparities in health status between older adults using and not using the home and community care services. The older adults with mild limited mobility had the highest service utilization rate of regular physical examination, while the severe limited mobility used less such service. Older people with mild limited mobility may have better health literacy than the ones with severe limited mobility and are more willing to seek preventive services actively such as regular physical examinations [53–55]. Older people with severe limited mobility may not have the ability to move around, and they may prefer home services to community services. But except family bed and onsite visit, the other items of the current home and community services are provided outside home. Policy makers should take into account the needs of older people who are with severe limited mobility when developing future home and community healthcare and daily care services. This current study demonstrated that the prevalence of depressive symptoms and depression was high in older adults with limited mobility. Compared to the older residents utilizing the home and community care services, the ones who did not utilize the services reported more severe conditions of depression. There were several possible explanations. Firstly, the more severe degree of depression would affect the compliance of older adults, which made it difficult for the population with limited mobility to actively seek home and community integrated healthcare and daily

Table 5 Theil indices and decomposition of Theil indices for the home and community care services utilization

	Total	Interregional	Intraregional	Eastern	Central	Western
Any one type						
TI	0.116	0.013	0.103	0.108	0.103	0.099
Contribution (%)		11.38	88.62	28.52	24.25	35.85
Regular physical examination						
TI	0.148	0.011	0.137	0.118	0.167	0.131
Contribution (%)		7.37	92.63	25.34	31.52	35.78
Onsite visit						
TI	0.241	0.015	0.226	0.363	0.056	0.249
Contribution (%)		6.30	93.70	41.19	6.52	45.98

care services. Secondly, the current home and community care services did not address the particular needs for mental health, while the total prevalence of depressive symptoms of older adults was up to 41.1% in China in 2015 [56]. Therefore, policy makers should pay more attention to the home and community care services utilization among older adults with depression and depressive symptoms and allocate resources to improve the accessibility among these populations.

Based on results from the Logit model and CI, the utilization of any one type of the home and community care services and the regular physical examination showed pro-rich inequities. This study found the highest magnitude of pro-rich inequity in the utilization of preventive care (CI of 0.120 for regular physical examination). This is consistent with the findings in England, which showed that compared with publicly-funded healthcare services, there were higher pro-rich inequities in preventive care, such as mammography and cervical screening [57]. The result can be explained by that poorer individuals have fewer resources to invest in using preventive care to improve health level [58]. The HI further examined the effect of socioeconomic characteristics and suggested pro-rich inequities. The results of this current study proved that income was the most important factor leading to inequity, both in the utilization of any one type of home and community care services and the utilization of the regular physical examination. It is possible that better-off individuals are more aware of the home and community care services, and they have more economic resources to get access to such services. At present, the home and community care services contain both free and paid packages. Older people with lower income levels may not afford paid services. Despite that there are some free healthcare and daily care services, older adults with lower income levels may lack resources to get access to such services. Therefore, policy makers need to take into account the income level when allocating resources relevant to the home and community care services, and develop tailored interventions to satisfy the needs of diverse populations.

Medical insurance was also found to be an important variable contributing to pro-rich inequity in regular physical examination, while less contributed to any one type of home and community care services. This was similar to a study which also found that medical insurance had higher effects on preventive service utilization than primary, and tertiary care service [59]. As the CI decomposition of the medical insurance variable was positive in this current study, having medical insurance aggravated pro-rich inequity. Specifically, UEBMI provided 46.66% contribution, followed by URBMI (7.55%) and URRBMI (0.08%), and NCMS reduced pro-rich inequity, with a

contribution of -38.59%. It could be explained by the fact that different types of basic medical insurance schemes in China differ in premium, financing structure and benefit design [30, 60]. Among the previous three basic medical insurance schemes, UEBMI requires the largest premium, has the highest reimbursement rate and the widest reimbursement coverage, while NCMS is completely the opposite. Physical examination fees are covered by UEBMI, but cannot be reimbursed by URBMI or NCMS. People with NCMS are rural residents, who usually have less privileged economic status than urban residents with URBMI. In consequence, having medical insurance, especially UEBMI, could enable the older adults with better economic status to use more regular physical examination services [61, 62]. The rather small contribution of URRBMI to pro-rich inequity indicated that the integration of URBMI and NCMS is progressing slowly. The gap between the different medical insurance systems needs to be narrowed so as to ensure that all citizens have equal access to basic public health services such as regular physical examination.

In terms of the allocation of medical resources such as medical institutions, physicians in China, the eastern region has the highest level, while the central region is higher than western [63]. However, the home and community care services utilization was highest in the western region and lowest in central in this study, which was similar to a previous study [64]. In China, there is no formal referral system, and the eastern and central regions are more prosperous than the west and have higher levels of health resources. Under such circumstances, residents in the eastern and central regions are inclined to use services provided by secondary and tertiary hospitals rather than primary health care facilities. But the home and community care services are mainly provided by primary health care facilities. That could explain why the home and community care services utilization were highest in the western region. CI decomposition analyses demonstrated that the eastern and central regions reduced the pro-rich inequity. A previous study showed that low-income patients were less likely to bypass primary care facilities than high-income patients [65]. It supports our research finding in the aspect that more older people of low-income levels in the eastern and central regions tend to use home and community care services, which are mainly provided in primary health care facilities. This finding indicates that the institutional problems of the health system should be addressed in the development of home and community integrated healthcare and daily care services. It follows that policy makers need to pay more attention to services utilization than health resource investment among home and community care services, especially in central region.

In this current study, TI values indicated a higher degree of services utilization inequity from intraregional contribution (about 90%) than from interregional contribution. The difference of the home and community care service utilization was great among provinces but minor across regions. Since many prior policies were implemented in the western region, the gap in medical resources between the eastern, central and western regions of China was gradually narrowing [64]. Equity of utilizing any one type service among different provinces was best in the western region, while equity of utilizing regular physical examination among different provinces was worst in the central region. As the home and community healthcare and daily care services were implemented by provincial governments, the findings indicated that there should be a large gap in service coverage and population coverage between different provinces. Although the western region is not as developed as the central and eastern regions, the difference in economic and social development among various western provinces is small [66]. This explains the relatively better equity of home and community care services utilization in the western region. It has been proved that the faster the economic development, the worse the inequity in health resource allocation in primary health institutions such as number of institutions, sickbeds, and physicians [67]. The inequity in health resource allocation may further lead to severer degrees of inequity in the home and community care service utilization in the central and eastern regions.

In this current study, the education levels of primary school and above reduced pro-rich inequity in utilizing home and community care services, which was consistent with previous studies [68]. Researchers found that older adults with higher education levels had higher health literacy and health awareness [69], so that they were less likely to overuse healthcare services [70].

Strengths and limitations

To the best of our knowledge, this current study may be the first to explore the needs and utilization of China's home and community integrated healthcare and daily care services and the inequity in services utilization. This current study used a large and nationally representative sample covering 28 provinces in China. Three complementary inequity analysis methods – CI, HI, and TI were applied to improve the accuracy of the analyses of inequity.

This current study had some limitations. Firstly, this study could not verify the inferences at the causal level with cross-sectional data. *The Guidelines on Promoting the Integration of Healthcare and Older Care Services*

(“*Guidelines*” for short) was issued in 2015. The 2018 CHARLS contained items on the home and community care services. But the latest 2020 wave did not involve such items. As a result, this current study could only analyze service utilization at the national level in 2018. Further research tracking the utilization of home and community care services are needed. Secondly, this study used the self-reported data from the respondents. Limited mobility in ADL was used to evaluate the needs of the home and community care services, thus a more systematic needs assessment system should be established to make up for the lack of self-reported data. Thirdly, participants with missing values on ADL items were excluded from the primary analyses in this current study, which may produce selection bias. Though the inverse probability weighting approach was used to verify the robustness, the possibility of selection bias could not be eliminated completely. More strict measures should be taken to guarantee response quality in future surveys. Finally, as the subjects of this study were older adults with limited mobility, service accessibility could not be analyzed from a perspective of service supply. Due to the same reason, we analyzed the equity in the utilization of home and community care services among older people with limited mobility instead of the whole population of older adults. The equity of service utilization among older people needs to be considered in subsequent studies.

Conclusions

This study contributed to literature on inequities in utilizing the home and community integrated healthcare and daily care services for older adults with limited mobility by using nationally representative evidence. As found in this study, there existed a contradiction of plenty of needs and insufficient utilization in the aspect of home and community care services. There was a pro-rich inequity in the utilization of different types of services. Medical insurance contributed to the pro-rich inequity in regular physical examination utilization. The difference of the home and community care service utilization was great among provinces but minor across regions. And the central region was the key area which had lower services utilization and higher degree of inequity. These findings warrant further attention to improve the accessibility of the home and community integrated healthcare and daily care services, in particular among the poorer older adults and the ones living in the central region in China, which have momentous policy implications to establish a more equitable integrated healthcare and daily care system for older adults.

Abbreviations

CHARLS	China Health and Retirement Longitudinal Study
ADL	Activities of daily living
PSMS	Physical Self-Maintenance Scale
NBS	National Census Bulletin from National Bureau of Statistics
UEBMI	Urban Employee Basic Medical Insurance
URBMI	Urban Resident Basic Medical Insurance
NCMS	New Cooperative Medical Scheme
URRBMI	Urban and Rural Resident Basic Medical Insurance
CESD	Center for Epidemiological Studies Depression Scale
CI	Concentration index
HI	Horizontal inequity index
TI	Theil index
IPW	Inverse probability weighting
SMD	Standardized mean differences

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12877-024-05328-z>.

Additional file 1: Appendix Table S1. Comparison of general characteristics between participants included and excluded due to ADL missing data ($n = 10823$). Appendix Figure S1. Standardized mean differences in general characteristics between included and excluded participants using samples with complete data on covariates. Appendix Figure S2. Standardized mean differences in general characteristics between included and excluded participants using samples applying multiple imputation for missing data on covariates. Appendix Table S2. Binary logistic regression analyses of the home and community care services utilization among participants with complete data on covariates based on the unweighted samples. Appendix Table S3. Binary logistic regression analyses of the home and community care services utilization among participants with complete data on covariates based on the inverse probability-weighted samples. Appendix Table S4. Binary logistic regression analyses of the home and community care services utilization among participants with multiple imputation data for missing values on covariates based on the unweighted samples. Appendix Table S5. Binary logistic regression analyses of the home and community care services utilization among participants with multiple imputation data for missing values on covariates based on the inverse probability-weighted samples. Appendix Table S6. Weighted general characteristics of older adults with limited mobility in China, 2018. Appendix Table S7. Weighted utilization rates of the home and community care services. Appendix Table S8. Weighted binary logistic regression analyses of the home and community care services utilization. Appendix Table S9: Binary logistic regression analyses of the regular physical examination service utilization. Appendix Table S10. Weighted binary logistic regression analyses of the regular physical examination service utilization. Appendix Table S11: Binary logistic regression analyses of the onsite visit service utilization. Appendix Table S12. Weighted binary logistic regression analyses of the onsite visit service utilization. Appendix Table S13. Weighted concentration indices for the home and community care services utilization. Appendix Table S14: Decomposition of concentration index for any one type service utilization. Appendix Table S15: Decomposition of concentration index for regular physical examination utilization

Acknowledgements

We thank the China Health and Retirement Longitudinal Study (CHARLS) team for providing data. This study was supported by the Public Health Policy and Management Innovation Research Team, which is an Excellent Innovation Team of Philosophy and Social Sciences in Jiangsu Universities granted by the Jiangsu Education Department. We would also like to thank all the participants in this study for their participation and collaboration. We sincerely thank the editor and the two anonymous reviewers for their constructive and helpful comments.

Authors' contributions

SC led the data analysis, interpreted the results and drafted the manuscript. PQ participated in data analysis. XW contributed to analysis framework design, results interpretation and commented on previous versions of the manuscript. DQ conceived the study and commented on previous versions of the manuscript. All authors have revised the manuscript and approved the final version.

Funding

This study is funded by General Research Project of Philosophy and Social Sciences in Jiangsu Universities granted by the Jiangsu Education Department (grant number: 2021SJA0309).

Availability of data and materials

The datasets analyzed during the current study are available in the CHARLS repository, <https://charls.pku.edu.cn/>.

Declarations

Ethics approval and consent to participate

Due to the fact that this was a secondary data analysis study, there was no need for the respondents' consent and no ethical conflict. Ethical approval of the original database was received at Peking University by their institutional review board (IRB approval number: IRB00001052-11015). All participants signed the informed consent when participated the survey.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

¹School of Health Policy and Management, Nanjing Medical University, No. 101 Longmian Avenue, Nanjing 211166, Jiangsu Province, China. ²School of Nursing, Nanjing Medical University, No.101 Longmian Avenue, Nanjing 211166, Jiangsu Province, China. ³Jiangsu Provincial Institute of Health, Nanjing Medical University, No.101 Longmian Avenue, Nanjing 211166, Jiangsu Province, China.

Received: 13 June 2023 Accepted: 23 August 2024

Published online: 07 September 2024

References

- Freedman VA, Kasper JD. Cohort Profile: The National Health and Aging Trends Study (NHATS). *Int J Epidemiol*. 2019;48(4):1044–1045g.
- Beard JR, Officer A, de Carvalho IA, Sadana R, Pot AM, Michel JP, Lloyd-Sherlock P, Epping-Jordan JE, Peeters G, Mahanani WR, et al. The World report on ageing and health: a policy framework for healthy ageing. *Lancet*. 2016;387(10033):2145–54.
- Bai C, Lei X. New trends in population aging and challenges for China's sustainable development. *China Economic Journal*. 2020;13(1):3–23.
- Wang Y, Wang J, Maitland E, Zhao Y, Nicholas S, Lu M. Growing old before growing rich: inequality in health service utilization among the mid-aged and elderly in Gansu and Zhejiang Provinces, China. *BMC Health Serv Res*. 2012;12:302.
- Fang EF, Scheibye-Knudsen M, Jahn HJ, Li J, Ling L, Guo H, Zhu X, Preedy V, Lu H, Bohr VA. A research agenda for ageing in China in the 21st century. *Ageing Res Rev*. 2015;24:197–205.
- Fang EF, Xie C, Schenkel JA, Wu C, Long Q, Cui H, Aman Y, Frank J, Liao J, Zou H, et al. A research agenda for ageing in China in the 21st century (2nd edition): Focusing on basic and translational research, long-term care, policy and social networks. *Ageing Res Rev*. 2020;64:101174.
- Chen X, Giles J, Yao Y, Yip W, Meng Q, Berkman L, Chen H, Chen X, Feng J, Feng Z, et al. The path to healthy ageing in China: a Peking University-Lancet Commission. *Lancet*. 2022;400(10367):1967–2006.

8. Yongmei W, Yanan L, Ying X. Effect of home-based care services on the quality of life for the elderly in China's urban and rural areas: analysis based on CLASS data. *Popul Res.* 2020;44(6):49.
9. Lv X, Zhang X. The influence of community home-based elderly care on the health of the elderly population. *Chin J Popul Sci.* 2022;3:111–25.
10. Wang J, Wang Y, Cai H, Zhang J, Pan B, Bao G, Guo T. Analysis of the status quo of the Elderly's demands of medical and elderly care combination in the underdeveloped regions of Western China and its influencing factors: a case study of Lanzhou. *BMC Geriatr.* 2020;20(1):338.
11. Wang Z, Wei H, Liu Z. Older Adults' Demand for Community-Based Adult Services (CBAS) Integrated with Medical Care and Its Influencing Factors: A Pilot Qualitative Study in China. *Int J Environ Res Public Health.* 2022;19(22):14869.
12. Ye L, Shia BC, Fang Y, Lee TS. Heterogeneous health profiles and health-care utilization of the middle-aged and elderly with multiple health insurance schemes in China. *Public Health.* 2019;170:61–9.
13. McQuade L, Merriman B, Lyford M, Nadler B, Desai S, Miller R, Mallette S. Emergency Department and Inpatient Health Care Services Utilization by the Elderly Population: Hurricane Sandy in The State of New Jersey. *Disaster Med Public Health Prep.* 2018;12(6):730–8.
14. Han J, Meng Y. Institutional differences and geographical disparity: the impact of medical insurance on the equity of health services utilization by the floating elderly population - evidence from China. *Int J Equity Health.* 2019;18(1):91.
15. Regidor E, Martínez D, Calle ME, Astasio P, Ortega P, Domínguez V. Socio-economic patterns in the use of public and private health services and equity in health care. *BMC Health Serv Res.* 2008;8:183.
16. García-Ramirez J, Nikoloski Z, Mossialos E. Inequality in healthcare use among older people in Colombia. *Int J Equity Health.* 2020;19(1):168.
17. Morris S, Sutton M, Gravelle H. Inequity and inequality in the use of health care in England: an empirical investigation. *Soc Sci Med.* 2005;60(6):1251–66.
18. Ruiz Gómez F, Zapata Jaramillo T, GaravitoBeltrán L. Colombian health care system: results on equity for five health dimensions, 2003–2008. *Rev Panam Salud Publica.* 2013;33(2):107–15 106 p preceding 107.
19. Li C, Dou L, Wang H, Jing S, Yin A. Horizontal inequity in health care utilization among the middle-aged and elderly in China. *Int J Environ Res Public Health.* 2017;14(8):842.
20. de Meijer CA, Koopmanschap MA, Koolman XH, van Doorslaer EK. The role of disability in explaining long-term care utilization. *Med Care.* 2009;47(11):1156–63.
21. Wang Y, Peng G, Huang Y, Li R, Cao J. Study on the outpatient layout optimization based on medical process simulation technology. In: *Advances in Urban Construction and Management Engineering.* CRC Press; 2023: 608–614.
22. Ilinca S, Rodrigues R, Schmidt AE. Fairness and Eligibility to Long-Term Care: An Analysis of the Factors Driving Inequality and Inequity in the Use of Home Care for Older Europeans. *Int J Environ Res Public Health.* 2017;14(10):1224.
23. Liu H, Hu T. Evaluating the long-term care insurance policy from medical expenses and health security equity perspective: evidence from China. *Arch Public Health.* 2022;80(1):3.
24. Yang C, Huang J, Yu J. Inequalities in resource distribution and healthcare service utilization of long-term care in China. *Int J Environ Res Public Health.* 2023;20(4):3459.
25. Zhao Y, Hu Y, Smith JP, Strauss J, Yang G. Cohort profile: the China Health and Retirement Longitudinal Study (CHARLS). *Int J Epidemiol.* 2014;43(1):61–8.
26. Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. *Gerontologist.* 1969;9(3):179–86.
27. Liao S, Wang G. Prevalence, changing trend of the elderly disability in China. *Chin J Popul Sci.* 2021;1:38–49.
28. Fan N, Tian F. WANG Y: Needs and utilization of health services and long-term care services among Chinese elderly: an empirical analysis based on CHARLS data. *Modern Prev Med.* 2018;45(9):1618–21.
29. Zhu H. Unmet needs in long-term care and their associated factors among the oldest old in China. *BMC Geriatr.* 2015;15:46.
30. Chen R, Li NX, Liu X. Study on the equity of medical services utilization for elderly enrolled in different basic social medical insurance systems in an underdeveloped city of Southwest China. *Int J Equity Health.* 2018;17(1):54.
31. Fu X, Sun N, Xu F, Li J, Tang Q, He J, Wang D, Sun C. Influencing factors of inequity in health services utilization among the elderly in China. *Int J Equity Health.* 2018;17(1):144.
32. Zuo X. Income of China's urban and rural elderly: changing structure and determinants. *Shanghai J Econ.* 2021;6:62–73.
33. Dong K. Medical insurance system evolution in China. *China Econ Rev.* 2009;20(4):591–7.
34. Zhang L, Chen R, Fang Y. Effects of Urban and Rural Resident Basic Medical Insurance on Healthcare Utilization Inequality in China. *Int J Public Health.* 2023;68:1605521.
35. Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. *Appl Psychol Meas.* 1977;1(3):385–401.
36. Andresen EM, Malmgren JA, Carter WB, Patrick DL. Screening for depression in well older adults: evaluation of a short form of the CES-D (Center for Epidemiologic Studies Depression Scale). *Am J Prev Med.* 1994;10(2):77–84.
37. Lin L, Wang HH, Lu C, Chen W, Guo VY. Adverse Childhood Experiences and Subsequent Chronic Diseases Among Middle-aged or Older Adults in China and Associations With Demographic and Socioeconomic Characteristics. *JAMA Netw Open.* 2021;4(10):e2130143.
38. Hu J, Zheng X, Shi G, Guo L. Associations of multiple chronic disease and depressive symptoms with incident stroke among Chinese middle-aged and elderly adults: a nationwide population-based cohort study. *BMC Geriatr.* 2022;22(1):660.
39. Wagstaff A, Paci P, van Doorslaer E. On the measurement of inequalities in health. *Soc Sci Med.* 1991;33(5):545–57.
40. Fan X, Su M, Zhao Y, Si Y, Zhou Z. Trends in equity of inpatient health service utilization for the middle-aged and elderly in China: based on longitudinal data from 2011 to 2018. *BMC Public Health.* 2021;21(1):1162.
41. Wagstaff A, O'Donnell O, Van Doorslaer E, Lindelow M: Analyzing health equity using household survey data: a guide to techniques and their implementation: World Bank Publications; 2007.
42. Wagstaff A, Van Doorslaer E: Measuring and testing for inequity in the delivery of health care. *J Hum Resour.* 2000:716–733.
43. Pulok MH, Hajizadeh M. Equity in the use of physician services in Canada's universal health system: a longitudinal analysis of older adults. *Soc Sci Med.* 2022;307:115186.
44. Harrell FE Jr, Lee KL, Mark DB. Multivariable prognostic models: issues in developing models, evaluating assumptions and adequacy, and measuring and reducing errors. *Stat Med.* 1996;15(4):361–87.
45. Li Z, Yang L, Tang S, Bian Y. Equity and Efficiency of Health Resource Allocation of Chinese Medicine in Mainland China: 2013–2017. *Front Public Health.* 2020;8:579269.
46. Zhang Y, Wang Q, Jiang T, Wang J. Equity and efficiency of primary health care resource allocation in mainland China. *Int J Equity Health.* 2018;17(1):140.
47. Su W, Du L, Fan Y, Wang P. Equity and efficiency of public hospitals' health resource allocation in Guangdong Province, China. *Int J Equity Health.* 2022;21(1):138.
48. Li C, Ma Y, Yang C, Hua R, Xie W, Zhang L. Association of Cystatin C Kidney Function Measures With Long-term Deficit-Accumulation Frailty Trajectories and Physical Function Decline. *JAMA Netw Open.* 2022;5(9):e2234208.
49. Dijkzeul A, Tiemeier H, Muetzel RL, Labrecque JA. Attention-deficit hyperactivity disorder symptoms and brain morphology: addressing potential selection bias with inverse probability weighting. *Hum Brain Mapp.* 2024;45(5):e26562.
50. Xia C. Community-based elderly care services in China: An analysis based on the 2018 wave of the CLHLS Survey. *China Popul Dev Stud.* 2020;3:352–67.
51. Huang C, Liu C-J, Pan X-F, Liu X, Li N-X. Correlates of unequal access to preventive care in China: a multilevel analysis of national data from the 2011 China Health and Nutrition Survey. *BMC Health Serv Res.* 2016;16(1):1–13.
52. Feng Z, Glinskaya E, Chen H, Gong S, Qiu Y, Xu J, Yip W. Long-term care system for older adults in China: policy landscape, challenges, and future prospects. *Lancet.* 2020;396(10259):1362–72.
53. MacLeod S, Musich S, Gulyas S, Cheng Y, Tkatch R, Cempellin D, Bhattarai GR, Hawkins K, Yeh CS. The impact of inadequate health literacy on

- patient satisfaction, healthcare utilization, and expenditures among older adults. *Geriatr Nurs*. 2017;38(4):334–41.
54. Köppen PJ, Dörner TE, Stein KV, Simon J, Crevenna R. Health literacy, pain intensity and pain perception in patients with chronic pain. *Wien Klin Wochenschr*. 2018;130:23–30.
 55. Glassman SD, Carreon LY, Brown ME, Jones JS, Edward J, Li J, Williams MV. The impact of health literacy on health status and resource utilization in lumbar degenerative disease. *Spine J*. 2019;19(4):711–6.
 56. Lu J, Xu X, Huang Y, Li T, Ma C, Xu G, Yin H, Xu X, Ma Y, Wang L, et al. Prevalence of depressive disorders and treatment in China: a cross-sectional epidemiological study. *Lancet Psychiatry*. 2021;8(11):981–90.
 57. Cookson R, Propper C, Asaria M, Raine R. Socio-economic inequalities in health care in England. *Fisc Stud*. 2016;37(3–4):371–403.
 58. Propper C. Why economics is good for your health. 2004 Royal Economic Society Public Lecture. *Health Econ*. 2005;14(10):987–97.
 59. Lee DC, Wang J, Shi L, Wu C, Sun G. Health insurance coverage and access to care in China. *BMC Health Serv Res*. 2022;22(1):140.
 60. Yip WC, Hsiao WC, Chen W, Hu S, Ma J, Maynard A. Early appraisal of China's huge and complex health-care reforms. *Lancet*. 2012;379(9818):833–42.
 61. Zhou M, Zhao S, Zhao Z. Gender differences in health insurance coverage in China. *Int J Equity Health*. 2021;20(1):52.
 62. Wang Z, Chen Y, Pan T, Liu X, Hu H. The comparison of healthcare utilization inequity between URRBMI and NCMS in rural China. *Int J Equity Health*. 2019;18(1):90.
 63. Wu RX, Chen LJ, Zhang YG, Cai Y, Wu SY. Regional difference in the matching degree of elderly population and health care resources distribution; 2023.
 64. Ding J, Hu X, Zhang X, Shang L, Yu M, Chen H. Equity and efficiency of medical service systems at the provincial level of China's mainland: a comparative study from 2009 to 2014. *BMC Public Health*. 2018;18(1):214.
 65. Li C, Chen Z, Khan MM. Bypassing primary care facilities: health-seeking behavior of middle age and older adults in China. *BMC Health Serv Res*. 2021;21(1):895.
 66. Zha B. The gap of economic development expanding between eastern China and middle, western China. *China Popul Res Newsl*. 1996;1:2–3.
 67. Yuanyuan W, Weiwei L, Jianjun H. Equity of health resource distribution in primary healthcare institutions in China. *Chin General Prac*. 2017;28(20):3451–6.
 68. Nurrika D, Zhang S, Discacciati A, Tomata Y, Liu Y, Sugawara Y, Tsuji I. Education Level, Monthly Per-Capita Expenditure, and Healthy Aging in the Older Indonesian Population: the Indonesia Family Life Survey 2007 and 2014. *Tohoku J Exp Med*. 2020;250(2):95–108.
 69. Xu J, Tian G, Sun J, Liu J, Chen F, Shi Q, Zhang T, Zhang H, He J, Deng F, et al. Horizontal inequity trends of health care utilization in rural China after the medicine and healthcare system reform: based on longitudinal data from 2010 to 2018. *Int J Equity Health*. 2023;22(1):90.
 70. Saito E, Gilmour S, Yoneoka D, Gautam GS, Rahman MM, Shrestha PK, Shibuya K. Inequality and inequity in healthcare utilization in urban Nepal: a cross-sectional observational study. *Health Policy Plan*. 2016;31(7):817–24.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.