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Heterogeneous health profiles and healthcare utilization of the middle-aged and elderly with multiple health insurance schemes in China

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ABSTRACT

Objectives: China is facing an escalating demand of healthcare services from the middle-aged and elderly. Compared with the traditional view of health on symptoms and diseases, this study aimed to assess the heterogeneous health profiles of middle-aged and elderly Chinese by a person-centered approach. Furthermore, this study examined the effects of health profiles and associated factors on healthcare utilization within the context of China's multiple health insurance schemes.

Study design: The study used the 2015 data of China Health and Retirement Longitudinal Study, a nationwide population-based sample of people aged 45 years and older.

Methods: Latent class analysis (LCA) was adopted to identify the heterogeneous health profiles. Two-part models were adopted to assess the effects of associated factors on healthcare utilization.

Results: Among 15,250 Chinese aged 45 years and older, six heterogeneous health profiles were identified and labeled as 'Quite Healthy', 'Relatively Healthy', 'Comprehensive Comorbidities', 'Functional Impairment', 'Severe Disability', and 'Relatively Frail'. The Relatively Frail profile was the heaviest healthcare user. The Severe Disability profile took the least use of outpatient services but had relatively high utilization of inpatient services and outpatient expenditure. The Comprehensive Comorbidities profile tended to have the smallest effect on the frequency of visits for both inpatient and outpatient services, but its effect on outpatient expenditure was high. After controlling for health profiles, the significant effects of different health insurance programs on healthcare utilization were discussed.

Conclusions: Introducing health profiles by the person-centered approach of LCA has provided a holistic understanding of complex healthcare demands for middle-aged and elderly

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Chinese. It is valuable for policy makers to improve healthcare resource allocation targeted for the middle-aged and elderly.

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Introduction

While population aging is a global phenomenon, China is aging much faster than most other countries.¹ The population of Chinese elderly is expected to have doubled – reaching about 491 million – by 2050.² Consequently, China is facing a significant health transition with dramatic increases in aging-associated diseases and disabilities. This leads to an escalating and composite demand of healthcare services not only from the elderly but also from the middle-aged, which will have significant impact over the next few decades.

To deal with the issue of healthcare utilization, the Andersen behavioral model is one of the most widespread research frameworks. The individual characteristics in the Anderson behavioral model comprise predisposing, enabling, and need factors.³ Previous studies applying this model pointed out that the strongest influence on healthcare utilization came from need factors involving physical, psychological, and perceived health.^{4,4–7} The important effects of health insurance as an enabling factor were also reported.¹

To assess the observable differences in health, studies on healthcare utilization adopted health indicators involving chronic diseases or comorbidities, self-reported health status, and disability indexes.^{1,8} Although these distinctions of health by symptoms and diseases are useful, they overlap with each other and act synergistically to impact the health outcome of the patients and their healthcare utilization.^{9–11} The variability and interdependency of multiple health indicators lead to the heterogeneous health for the middle-aged and elderly.¹² The heterogeneity of health may be introduced through relationships between different health indicators and then presented as possible health subgroups that exhibit similar characteristics of health indicators. For the effects of influencing factors on healthcare utilization, it is likely to neglect the important relationships between health and healthcare utilization when hidden heterogeneity is not taken into account.^{6,13} To deal with the heterogeneity of health and its effect on healthcare utilization, there is an increasing recognition of shifting the traditional view of health on symptoms and diseases to the vertical perspective of health by person-centered approaches.^{6,7,13–15} However, there has been no comprehensive discussion on the heterogeneity of health for the middle-aged and elderly, nor an assessment of its effect on healthcare utilization within the context of multiple health insurance schemes in China.

China's multiple health insurance schemes have covered 95% of the total population since 2011 and mainly include three insurance programs: New Rural Cooperative Medical Scheme (NRCMS), Urban Resident Basic Medical Insurance (URBMI), and Urban Employee Basic Medical Insurance (UEBMI).^{16,17} The three main insurance programs are designed

on the basis of the household residence registration system (also known as the 'Hukou' system) and/or the person's employment status, and these insurances differ in the premiums, benefit packages, and reimbursement rates.¹⁸ In contrast with massive population migration from rural areas to urban areas, it is not easy to transfer the Hukou from rural residences to urban residences,¹⁹ making it difficult to shift across the three main insurance programs.

Within the context of China's multiple health insurance schemes, this study served three purposes. First, this study assessed the heterogeneous health profiles for residents aged 45 years and older based on the person-centered approach of latent class analysis (LCA). Second, this study compared the patterns of healthcare utilization among different health profiles. Third, this study assessed the effects of health profiles and associated factors on healthcare utilization by two-part models.

Methods

Data source and study population

Data came from the China Health and Retirement Longitudinal Study (CHARLS), a public database with a nationwide population-based sample of people aged 45 years and older and their spouses.^{20,21} The CHARLS contains information on socio-economic status, health status and function, healthcare and insurance, and household characteristics. Three waves of CHARLS were conducted in 2011, 2013, and 2015. More details can be obtained in the study by Zhao et al.²⁰ The newest wave of data, with a total of 20,936 respondents in 2015, was used for this study. Records with missing data were excluded.

Variable definitions

This study adopted 17 health indicators to assess heterogeneous health profiles. The health indicators contained health conditions, sensory limitations, and functional impairments.

Health conditions (yes, no) involved self-reported hypertension, dyslipidemia, diabetes, chronic lung diseases, liver diseases, heart problems, stroke, kidney diseases, stomach or other digestive diseases, arthritis or rheumatism, and asthma. Sensory limitations (yes, no) referred to self-declared problems of hearing and vision. Self-rated health was defined by poor or good. Cognitive problems were evaluated by 12-item scores: today's date (year, month, day); day of the week; current season; test of serial subtractions of 7 from 100 (up to five times); no use of paper, pencil, or any other aid for number subtractions; and ability to reproduce a picture of two overlapped pentagons.²⁰ Those with a score less than a median of 7 were defined as having cognitive problems. Depression (yes,

no) was measured by Center for Epidemiologic Studies 10-item scores, with a score above 10 being considered depressed. Functional impairments involved activities of daily living (ADLs) and instrumental ADLs (IADLs). ADLs include dressing, bathing, eating, getting into or out of bed, using the toilet, and controlling urination and defecation. IADLs include doing household chores, preparing hot meals, making phone calls, taking medications, shopping, and managing assets. Those needing help in any one of ADLs or IADLs were defined as having difficulties. The measure of ADLs was defined as activities with no difficulty or with difficulties; meanwhile, the measure of IADLs was defined as 0 activities with difficulties, 1–3 activities with difficulties, or 4 or more activities with difficulties.

Healthcare utilization involved outpatient utilization during the past month and inpatient utilization during the past year. The likelihood of utilization, frequency of visits, and expenditure were collected.

Based on the Andersen behavioral model, predisposing factors included gender, age, marital status (married or partnered, divorced or separated or widowed, single), education (illiterate, literate or primary school, junior high and above), household size, and living status (alone, spouse only, co-residency with others). Enabling factors contained household registration (rural, non-rural),¹ household income, and health insurance. China's multiple health insurance schemes comprise NRCMS, URBMI, UEBMI, and complementary health insurance schemes, which involve Government Medical Insurance (GMI), Medical Assistance, commercial health insurance, and others. GMI with high reimbursement rates is built for the employees from government and public institutions, and its enrollees have transferred to UEBMI since 2010.²² Medical Assistance is a free and voluntary health insurance program and provides a safety net for the health of poor residents. Except for those enrolling in NRCMS only, UEBMI only, URBMI only, and GMI only, other people enroll in other or more than two insurance programs for various reasons. Although people are usually allowed to enroll in only one of the three main insurance programs, there still exist the irregularities of enrolling in two of the three insurances.²³ Poor individuals enrolling in main insurances can still seek support from Medical Assistance.²⁴ People with high income may purchase additional commercial insurance, but the coverage of commercial insurance is still low in China.²⁵ Therefore, health insurance in our study was defined as six groups: NRCMS only, UEBMI only, URBMI only, GMI only, other or more than two insurance programs, and no insurance.

Statistical analyses

The statistical analyses of this study contained three parts. First, this study adopted LCA to identify the classification of health profiles and estimate conditional health indicator probabilities and health profile probabilities. LCA is a person-centered approach suitable to tackle the issue of heterogeneity. Through considering relationships among observed health indicators, LCA is able to identify the smallest number of unobserved groups of individuals by latent classes, i.e., health profiles.^{6,7,13–15} Conditional health indicator probability was the indicator-response probability, representing the

association between health profile and observed indicator variables.²⁶ Health profile probability was used to measure an individual's probability of belonging to a particular health profile, and the individual was assigned to the profile with the highest probability.^{6,27} LCA models with 2–9 profiles were conducted. Bayesian Information Criterion (BIC), Consistent Akaike's Information Criterion (cAIC), and adjusted BIC (aBIC) were adopted to compare the performance of different LCA models.

Second, this study adopted non-parametric tests such as the Bartlett test, Kruskal-Wallis test, and Steel-Dwass test to validate local independence of each profile and compare the differences in healthcare utilization among different health profiles.

Finally, this study adopted two-part models to evaluate the effects of need, predisposing, and enabling factors on healthcare utilization. The zero-altered negative binomial model was used to analyze the frequency of healthcare visits. Healthcare expenditure was fit by logistic model at the first part of the two-part model and ordinary least square model with the log-transformed at the second part. All statistical analyses were performed using R, version 3.3.3.²⁸ A P-value below 0.05 was regarded as statistically significant.

Results

Health profiles of the middle-aged and elderly

The study population consisted of 15,250 Chinese residents aged 45 years and older, and their characteristics are presented in [Table 1](#). Considerable heterogeneity was shown among health indicators. Among the 11 chronic diseases, arthritis or rheumatism, hypertension, and stomach or other digestive diseases were the three most common diseases, and the prevalence of stroke, liver diseases, and asthma were relatively lower than others.

The LCA model with six profiles obtained the smallest BIC (143,332.8) and cAIC (143,409.8) ([Fig. 1](#)). Thus, this study classified the study population into six latent health profiles.

In the final LCA model, 11 health indicators were selected ([Table 2](#)). The labels of health profiles were assigned according to conditional health indicator probabilities. The first profile tended to have the lowest prevalence of most diseases, the lowest probability of poor self-rated health, and the highest probability of IADLs difficulties with 0 activities. Hence, the study labeled this health profile as 'Quite Healthy'. By contrast, the sixth profile tended to have the highest prevalence of most diseases, the highest probabilities of sensory limitations, and poor self-rated health and was labeled as 'Relatively Frail'. The health status of the second profile was relatively fair and was labeled as 'Relatively Healthy'. The third profile, 'Comprehensive Comorbidities', was prone to relatively high prevalence of most diseases and had the highest probability of hypertension. The fourth profile, 'Functional Impairment', was prone to relatively high probabilities of sensory limitations, poor self-rated health, and ADLs difficulties and had the highest probabilities of depression and IADLs difficulties with 1–3 activities. The fifth profile was defined as 'Severe Disability' because of its highest

Table 1 – Characteristics of the middle-aged and elderly.

Variable	N or mean	% or Std.
Gender		
Male	7318	47.99
Female	7932	52.01
Age (mean years)	61.27	9.72
Marital status		
Married or partnered	13198	86.54
Divorced or separated or widowed	1938	12.71
Single	114	0.75
Education		
Illiterate	3810	24.98
Literate or primary school	9476	62.14
Junior high and above	1964	12.88
Household size (mean no. of people)	2.19	0.89
Living status		
Alone	1846	12.10
Spouse only	9786	64.17
Coresidency with others	3618	23.72
Household registration		
Rural	10993	72.09
Non-rural	4257	27.91
Household income (mean CNY)	18,429.69	78,715.05
Health insurance		
NRCMS only	9819	64.39
UEBMI only	1461	9.58
URBMI only	597	3.91
GMI only	148	0.97
Other or >2 insurance programs	2771	18.17
No insurance	454	2.98
Health status		
Hypertension	4243	27.82
Dyslipidemia	1825	11.97
Diabetes	1113	7.30
Chronic lung diseases	1528	10.02
Liver diseases	545	3.57
Heart problems	2006	13.15
Stroke	330	2.16
Kidney diseases	932	6.11
Stomach or other digestive diseases	3349	21.96
Arthritis or rheumatism	4760	31.21
Asthma	558	3.66
Sensory limitations	8355	54.79
Self-rated health	3787	24.83
Cognitive problem	5552	36.41
ADLs difficulties	3071	20.14
IADLs difficulties		
0 activity	11844	77.67
1–3 activities	2709	17.76
4 or more activities	697	4.57
Depression	4199	27.53

N: number; Std.: standard error; CNY: Chinese yuan; NRCMS: New Rural Cooperative Medical Scheme; URBMI: Urban Resident Basic Medical Insurance; UEBMI: Urban Employee Basic Medical Insurance; GMI: Government Medical Insurance; ADLs: activities of daily living; IADLs: instrumental activities of daily living.

probabilities of ADLs and IADLs difficulties with 4 or more activities.

Healthcare utilization of the six health profiles

For outpatient utilization, nearly one-fifth of the middle-aged and elderly took, on average, two or three visits during the

past month and spent an average of about CNY 1294 (USD 199; CNY 6.5 per USD) per visit (Table 3). The Relatively Frail and Functional Impairment profiles were more likely to use outpatient services (38.69% and 27.60%, respectively). Among the users of outpatient services, the results of non-parametric tests showed significant heterogeneity of outpatient utilization among the six profiles. The Relatively Frail profile took the most outpatient visits (2.97), and the Quite Healthy profile took the least use (1.97) and cost the least of all the profiles (CNY 999.60, USD 153.78). The Relatively Healthy profile took more outpatient visits than the Quite Healthy and Comprehensive Comorbidities profiles (2.32, 1.88, and 2.12, respectively). For the Severe Disability profile, the likelihood of outpatient utilization was only higher than the Quite Healthy profile (20.35% and 13.41%, respectively), but the average outpatient expenditure was the highest (CNY 3649.86, USD 561.52).

For inpatient utilization, about one-seventh of the middle-aged and elderly took, on average, one or two visits during the past year, and their average expenditure was about CNY 11,642 (USD 1791) per visit (Table 3). The Relatively Frail and Severe Disability profiles were more likely to be hospitalized (38.54% and 25.60%, respectively). Among the users of inpatient services, significant heterogeneity of inpatient utilization among six profiles was found. The Relatively Frail profile took the most inpatient visits (1.83) and cost the most (CNY 15,338.18, USD 2359.72). The Quite Healthy profile was the least likely to be hospitalized (7.09%), but its average inpatient expenditure (CNY 10,339.29, USD 1590.66) was higher than that of the Relatively Healthy profile (CNY 9108.44, USD 1401.30).

Effects of health profiles and other factors on outpatient utilization

After controlling for predisposing and enabling factors, the results of two-part models on three measures of outpatient utilization all indicated significant effects of different health profiles when the Quite Healthy profile was set as the reference (Table 4). The Relatively Frail profile had the highest effect on all three measures. Except for the Relatively Frail profile, the effects of the Functional Impairment profile on the likelihood of utilization and the frequency of visits (odds ratio [OR]: 2.50 and 2.17, respectively) were the highest, whereas the effect of the Severe Disability profile on the expenditure (coefficient: 0.74) was the highest. The Relatively Healthy profile had a higher effect on the likelihood of outpatient utilization and the frequency of outpatient visits (OR: 2.40 and 1.60, respectively) than Comprehensive Comorbidities profile did (OR: 2.27 and 1.35, respectively).

For predisposing factors, female individuals or those having junior high and above education were more likely to use outpatient services (OR: 1.18 and 1.25, respectively). Being female or single tended to take more outpatient visits (OR: 1.20 and 2.73, respectively). Those with lower age, with junior high and above education, or living with spouse only were prone to costing more outpatient expenditure (coefficient: -0.02, 0.52, and 0.41, respectively).

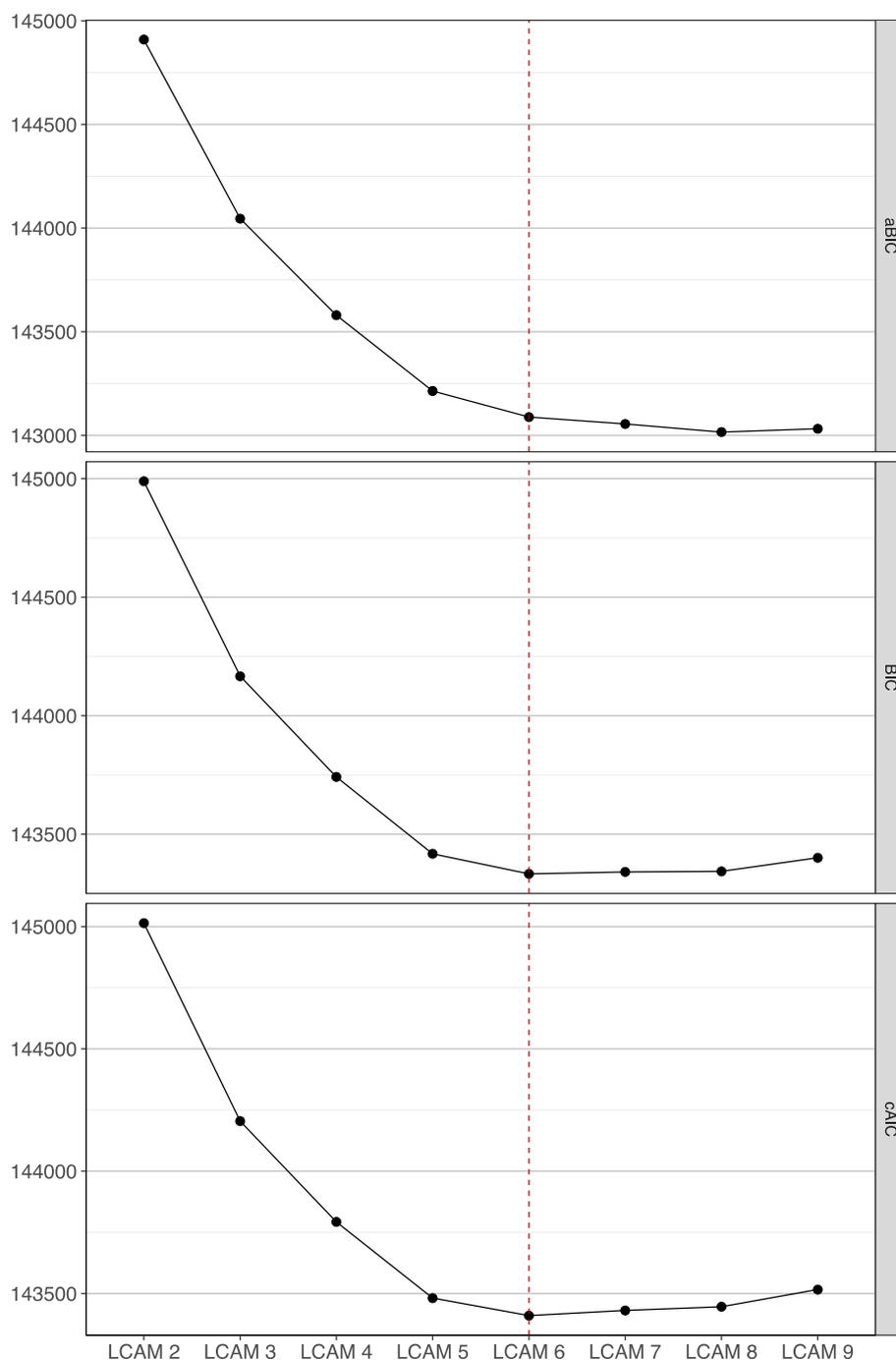


Fig. 1 – The performance of Latent class analysis models (LCAMs). LCAM 2–LCAM 9: LCA models with 2–9 profiles, respectively; BIC: Bayesian Information Criterion; cAIC: Consistent Akaike's Information Criterion; aBIC: adjusted BIC.

For enabling factors, the effects of household registration on outpatient utilization were not significant when rural area was set as reference. Those with higher household income were more likely to use outpatient services (OR: 1.02). Those with URBMI only and other or more than two insurance programs were less likely to use outpatient services (OR: 0.75 and 0.88, respectively), and those with URBMI only accounted for more outpatient expenditure than NRCMS only did (OR: 0.40).

Effects of health profiles and other factors on inpatient utilization

The results of two-part models on inpatient utilization indicated significant effects of different health profiles on the likelihood of utilization and frequency of visits, whereas only the Relatively Frail profile had a significant influence on the inpatient expenditure (OR: 0.53) when the Quite Healthy profile was set as the reference (Table 4). For the impact on the

Table 2 – Conditional probabilities (%) of health indicators in each profile.

Health indicators	Quite Healthy (N = 8212)	Relatively Healthy (N = 3415)	Comprehensive Comorbidities (N = 1466)	Functional Impairment (N = 1000)	Severe Disability (N = 462)	Relatively Frail (N = 659)
Hypertension	14.50	25.58	64.46	29.12	53.65	62.17
Liver diseases	1.34	4.61	6.65	2.31	1.57	15.49
Heart problems	2.14	10.29	43.24	6.61	20.76	64.74
Stroke	0.29	0.61	4.50	6.15	16.41	8.79
Kidney diseases	1.65	7.10	12.04	4.53	7.65	31.20
Arthritis or rheumatism	15.26	47.35	35.37	52.57	33.30	68.87
Sensory limitations	40.77	70.47	58.05	78.84	41.29	84.25
Self-rated health	3.16	43.87	26.10	70.24	19.14	85.85
ADLs difficulties	1.97	26.04	8.41	85.99	95.78	68.71
IADLs difficulties						
0 activity	94.72	76.67	89.16	0.00	8.59	26.76
1–3 activities	4.79	23.33	10.84	68.58	43.25	55.02
4 or more activities	0.49	0.00	0.00	31.42	48.17	18.21
Depression	9.19	51.20	11.48	79.04	3.93	78.81

N: number. ADLs: activities of daily living; IADLs: instrumental activities of daily living.

likelihood of inpatient utilization, the order of health profiles from high to low was Relatively Frail, Severe Disability, Functional Impairment, Comprehensive Comorbidities, and Relatively Healthy (OR: 7.87, 4.90, 4.29, 3.27, and 2.99, respectively), as well as for the influence on the frequency of outpatient visits, the Relatively Healthy profile had a higher effect on the frequency of inpatient visits than the Comprehensive Comorbidities profile did (OR: 2.20 and 2.11, respectively).

For predisposing factors, male individuals (female OR: 0.89) or those with greater age (OR: 1.02) were more likely to be hospitalized. Age had a significant impact on the frequency of inpatient visits and inpatient expenditure (OR: 1.02; coefficient: -0.02). Being single accounted for less inpatient expenditure than being married or partnered did (coefficient: -1.92). As for education, no significant effect on inpatient utilization was found.

For enabling factors, the effects of household registration on inpatient utilization were not significant and the same for outpatient utilization. Those with higher household income were more likely to be hospitalized and spend more on inpatient expenditures (OR: 1.02; coefficient: 0.04). Those with URBMI only accounted for more utilization and expenditure of inpatient services than NRCMS only did (OR: 1.37; coefficient: 0.65).

Discussion

Based on the synergistic combination of multiple health indicators by the person-centered approach of LCA, this study provided a comprehensive description on the heterogeneous health of middle-aged and elderly Chinese. Six health profiles were identified and characterized by different health problems. A previous study on 1064 elderly Canadians and another study on 1491 elderly Taiwanese both identified four latent health profiles.^{6,13} By contrast, this study consisted of a much larger sample size with 15,250 Chinese, and the age range of the sample was larger than that in these other two studies, leading to a more complex issue of identifying the

heterogeneity of health. Subsequent tests and modeling of healthcare utilizations suggest that the six health profiles revealed by LCA provide a clear distinction of health and build a valid base to compare the pattern of healthcare utilization.

The effects of health profiles as need factors of healthcare utilization were significant for the likelihood of utilization, frequency of visits, and expenditure among both outpatient and inpatients services. The heaviest healthcare user among the six profiles was the Relatively Frail profile. The Severe Disability profile used the fewest outpatient services but had high utilization of inpatient services and high outpatient expenditure. Similar findings have been pointed out not only by domestic studies but also by international research in the context of better healthcare and long-term care services.^{1,6,13,29} The healthcare need of frail or disabled elderly may be partially shifted or covered by health insurance systems,⁶ urgently calling for the supplement of long-term care services.

Among the Functional Impairment, Comprehensive Comorbidities, and Relatively Healthy profiles, the Comprehensive Comorbidities profile tended to have the lowest effect on the frequency of visits for both inpatient and outpatient services, whereas the effect on the outpatient expenditure was the highest. By contrast, those with high comorbidities in Taiwan's study had higher likelihood of both ambulance and inpatient services utilization than those being relatively healthy.⁶ The pattern of healthcare utilization for the Comprehensive Comorbidities profile may reveal relatively high financial risk from chronic diseases under present health insurance system. Although health management programs or guidelines are increasingly implemented in healthcare systems globally,^{30,31} their effects of reducing the burden on healthcare systems remain to be improved by better understanding of health needs of the middle-aged and elderly population, along with their healthcare utilization.

For predisposing factors, gender differences on the likelihood of healthcare utilization were significant, whereas those on healthcare expenditure were not significant, consistent with previous studies.^{1,6,7} People who were single tended to cost less inpatient expenditure to evade financial

Table 3 – Utilization of healthcare services among six health profiles.

Health profiles and non-parametric tests	Outpatient				Inpatient					
	Users		Frequency of visits		Users		Frequency of visits		Expenditure (CNY)	
	Number	%	Mean	Std.	Number	%	Mean	Std.	Mean	Std.
Overall	3041	19.94	2.23	2.44	2192	14.37	1.50	1.08	11,642.04	21,389.22
Quite Healthy	1101	13.41	1.88	1.97	582	7.09	1.25	0.86	10,339.29	17,162.22
Relatively Healthy	930	26.95	2.32	2.25	639	18.52	1.51	1.13	9108.44	17,081.05
Comprehensive Comorbidities	385	26.26	2.12	2.25	317	21.62	1.52	1.08	14,334.93	26,019.62
Functional Impairment	276	27.60	2.75	3.32	256	25.60	1.57	0.86	12,264.91	21,869.17
Severe Disability	94	20.35	2.47	2.79	144	31.17	1.71	1.30	14,595.19	23,805.52
Relatively Frail	255	38.69	2.97	3.48	254	38.54	1.83	1.34	15,338.18	29,216.38
Test results										
Bartlett test P-value			<0.001				<0.001		<0.001	
Kruskal-Wallis test P-value			<0.001				<0.001		<0.001	
Steel-Dwass test			QH, RH, CC < FG				QH, RH, CC < FG		RH < QH, CC, FI, FG	
			QH, CC < FI				QH < RH, CC, FI, SD			
			QH < RH				QH < RH, FI			

Std.: standard error; CNY: Chinese yuan; QH, quite healthy; RH, relatively healthy; CC, comprehensive comorbidities; FI, functional impairment; SD, severe disability; RF, relatively frail.

risk. People with higher education accounted for more use of outpatient services and more outpatient expenditure, likely because highly educated people are more health-conscious.¹

For enabling factors, the effects of household registration on both outpatient and inpatient utilization were not significant. NRCMS as one of China's three main health insurances has improved the accessibility of healthcare services for rural residents,¹ and it may contribute to eliminating the disparities of health among rural and non-rural areas. Household income had significant effects on the likelihood and expenditure of healthcare services, which indicated that economic barriers to healthcare services still exists. By contrast, a related study in elderly Taiwanese showed that economic status had no significant effect on the likelihood and expenditure of healthcare services,⁶ reflecting the relative fairness of Taiwan's health insurance. Therefore, implementing new unified health insurance should also focus on benefiting the poor in either rural or urban areas to avoid the regressive benefit on the urban rich.³²

By controlling for health profiles, this study showed the different effects of different health insurance programs on healthcare utilization for middle-aged and elderly Chinese, similar to the findings of previous studies.¹⁶ Although patients with URBMI tended to use fewer outpatient services than those with NRCMS, the impact on other healthcare utilization was not significantly different. The effect of UEBMI was significant not only on the likelihood of inpatient utilization but also on the healthcare expenditure for both outpatient and inpatient services when NRCMS was set as reference. Owing to the main barrier of the Hukou system, it is difficult to shift across three different insurances with different target populations.¹⁸ In response to the rural-urban disparities, the Chinese government put forward a reform of the new household registration system in 2014 to eliminate the division between rural and urban Hukou status by 2020³³ and has since began to merge NRCMS and URBMI into a unified basic health insurance system for rural and urban residents.³⁴ Special attention should be paid to the gap in health insurance between urban employees and others. To provide equitable and efficient healthcare services for both employees and residents across rural and urban areas, heterogeneous health profiles could be taken into account to adequately assess the impact of health insurance systems.

Several limitations existed in this study. More health indicators could be collected for better assessment of health profiles. This study was based on cross-sectional analyses, but longitudinal data of health may help to provide a time-adjusted understanding of the associations among health profiles, multiple health insurance schemes, and healthcare utilizations for further study. Also, according to the feedback loops in the newest revised version of the Andersen health behavior model, more perspectives may be considered for the impact of health profiles and other associated factors on the pattern of healthcare utilization.

In summary, this study adopted the 2015 data of CHARLS to assess the heterogeneous health profiles for residents aged 45 years and older by the person-centered approach of LCA. Six health profiles were identified and characterized by different

Table 4 – Effects of health profiles and other factors on healthcare utilization.

Variables	Outpatient						Inpatient					
	Part I		Part II				Part I		Part II			
	OR	P-value	Visit frequency		Expenditure		OR	P-value	Visit frequency		Expenditure	
			OR	P-value	Coef.	P-value			OR	P-value	Coef.	P-value
Health profiles												
Quite Healthy	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Relatively Healthy	2.40	<0.01	1.60	<0.01	0.38	<0.01	2.99	<0.01	2.20	<0.01	−0.27	0.09
Comprehensive Comorbidities	2.27	<0.01	1.35	0.01	0.71	<0.01	3.27	<0.01	2.11	<0.01	0.32	0.10
Functional Impairment	2.50	<0.01	2.17	<0.01	0.52	<0.01	4.29	<0.01	2.36	<0.01	−0.08	0.72
Severe Disability	1.75	<0.01	1.81	0.01	0.74	<0.01	4.90	<0.01	2.72	<0.01	0.35	0.18
Relatively Frail	4.14	<0.01	2.56	<0.01	1.14	<0.01	7.87	<0.01	3.59	<0.01	0.53	0.01
Gender												
Male	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Female	1.18	<0.01	1.20	0.02	−0.03	0.73	0.89	0.03	1.00	0.99	−0.25	0.05
Age												
Age	1.00	0.22	1.00	0.42	−0.02	<0.01	1.02	<0.01	1.02	<0.01	−0.02	0.01
Marital status												
Married or partnered	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Divorced, separated, or widowed	1.12	0.18	0.84	0.26	0.14	0.42	1.06	0.54	0.80	0.24	−0.36	0.14
Single	1.30	0.28	2.73	0.01	−0.41	0.39	1.17	0.55	1.15	0.78	−1.92	<0.01
Education												
Illiterate	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Literate or primary school	1.07	0.20	1.01	0.90	0.10	0.35	0.98	0.75	1.05	0.64	0.23	0.11
Junior high and above	1.25	0.01	1.13	0.40	0.52	<0.01	0.96	0.65	0.99	0.98	0.32	0.18
Household size												
Household size	1.03	0.41	0.97	0.60	−0.05	0.49	1.03	0.57	1.10	0.27	0.00	0.97
Living status												
Alone	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Spouse only	1.16	0.09	0.98	0.89	0.41	0.02	1.00	0.97	0.95	0.79	−0.14	0.58
Coresidency with others	1.10	0.38	1.15	0.46	0.42	0.05	0.96	0.73	0.72	0.21	−0.41	0.18
Household registration												
Rural	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Non-rural	0.97	0.66	1.04	0.71	−0.09	0.44	0.94	0.37	1.11	0.47	−0.07	0.68
Household income	1.02	<0.01	0.99	0.23	0.02	0.16	1.02	0.01	1.01	0.57	0.04	0.03
Health insurance												
NRCMS only	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
UEBMI only	1.02	0.79	1.03	0.85	0.40	0.02	1.37	<0.01	1.16	0.47	0.65	0.01
URBMI only	0.75	0.02	0.76	0.22	0.14	0.58	1.19	0.18	1.08	0.75	0.20	0.53
GMI only	1.18	0.42	0.94	0.86	−0.11	0.79	1.00	0.99	1.08	0.87	−0.26	0.66
Other or >2 insurance programs	0.88	0.03	1.04	0.69	0.12	0.30	1.00	0.98	1.18	0.21	0.16	0.32
No insurance	0.99	0.93	0.90	0.63	0.01	0.96	1.10	0.52	1.30	0.37	0.23	0.53

OR: odds ratio; Coef.: coefficient; NRCMS: New Rural Cooperative Medical Scheme; URBMI: Urban Resident Basic Medical Insurance; UEBMI: Urban Employee Basic Medical Insurance; GMI: Government Medical Insurance. Ref.: reference.

health problems. Subsequent tests and modeling on healthcare utilization suggested that latent health profiles provided a clear distinction of middle-aged and elderly health. Introducing health profiles provided a holistic understanding of complex healthcare demands in the middle-aged and elderly. It will be valuable for policy makers to adequately assess the health policy and allocation of healthcare resources aimed at improving healthcare efficiency and quality for the middle-aged and elderly.

Author statements

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Ethical approval

Not required. Data came from the public database of China Health and Retirement Longitudinal Study (CHARLS). The original CHARLS was approved by the Ethical Review Committee of Peking University, and all participants signed informed consent at the time of participation.

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Competing interests

None declared.

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