Article

The relationship between accessibility of healthcare facilities and medical care utilization among the middle-aged and elderly population in Taiwan

YA-TING YANG[1,2], USMAN IQBAL[3], HUA-LIN KO[2,4], CHIA-RONG WU[2,4], HSIEN-TSAI CHIU[2,5], YI-CHIEH LIN[2,4], WENDER LIN[6], and YI-HSIN ELSA HSU[2,4]

[1]Institute of Health Policy and Management, National Taiwan University, Taipei, Taiwan, [2]Golden Dream Think Tank and Research Center, Taiwan, [3]Graduate Institute of Biomedical Informatics, College of Medical Science and Technology, Taipei Medical University, Taipei, Taiwan, [4]School of Health Care Administration, Taipei Medical University, Taipei, Taiwan, [5]Department of Public Health, China Medical University, Taichung, Taiwan, and [6]Department of Health Care Administration, Chang Jung Christian University, Tainan, Taiwan

Address reprint requests to: Yi-Hsin Elsa Hsu, School of Health Care Administration, Taipei Medical University, Taipei, Taiwan. Tel: +886-2-27361661; E-mail: elsahsu@tmu.edu.tw

Abstract

Objective: The purpose of this study was to explore the relationship between accessibility of healthcare facilities and medical care utilization among the middle-aged and elderly population in Taiwan.
Design: Cross-sectional study from 2007 Taiwan Longitudinal Study on Ageing (TLSA) survey.
Setting: Community-based study.
Participants: A total of 4249 middle-aged and elderly subjects were recruited.
Intervention(s): None.
Main Outcome Measure(s): Outpatient visits within 1 month, and hospitalization, emergency visits as well as to shop in pharmacy stores within 1 year, respectively.
Results: Adjusting for important confounding variables, the middle-aged and elderly with National Health Insurance (NHI) and commercial insurance compared with those with NHI alone tended to have outpatient visits. The middle-aged and elderly with longer time to access healthcare facilities were less likely to shop in pharmacy stores compared with those with <30 min. The middle-aged and elderly who perceived inconvenient to access health care tended to shop in pharmacy stores compared with those with perceived convenience.
Conclusions: Our study of Taiwan's experience could provide a valuable lesson for countries that are planning to launch universal health insurance system, locate budgets in health care and transportation. The middle-aged and elderly who were facing more challenges in accessing health care, no matter in perceived accessibility or real time to access health care, had less outpatient visits and more drug stores shopping. Strategic policies are needed to improve accessibility in increasing patients' perception on access and escalating convenience of transportation system for improving accessibility.

Key words: accessibility, middle-aged and elderly, medical care utilization, healthcare quality, patient safety

Introduction

Population ageing is a global trend. The global population aged 65 years or older were 524 million people in 2010 (8% of world's population) and expected to increase to about 1.5 billion (16% of world's population) by 2050, with most of the increase in developing countries (http://www.nia.nih.gov/sites/default/files/global_health_and_aging.pdf (5 March 2015, date last accessed)). By the end of September 1993, 7.09% of Taiwan's total population were over 65 years, and reached the ageing society standard set by World Health Organization. 32.5% population are aged greater than 50 in 2013 from household registration data, and 11.53% for 65 years and above with an ageing index of 80.51%. The increase in this sustained phenomenon in the elderly population is expected to increase by 2025 to 20.1% (http://sowf.moi.gov.tw/stat/Survey/list.html).

According to the Taiwan National Health Insurance 2012 Annual Report, 46.8% of total medical care visits (including outpatients, ER visits and inpatient admissions) were utilized by patients over 50 years, and 12.5% by patients over 65 years; 62.1% of total medical expenditures were cost by patients over 50 years and 34.6% by patients over 65 years.

Assessment of quality of care includes the following dimension: resource availability, patient–provider relationship, patient satisfaction, quality indicators, clinical practice, assess and continuity of care and also patient safety [1]. Accessibility of healthcare resources is particularly important for the physiological functions in the middle-aged and elderly population. Accessibility can be summarized by five dimensions: availability, accessibility, accommodation, affordability and acceptability [2]. The degree of accessibility to health care is related to the capacity and willingness to use health care [3, 4]. Elder patient's accessibility to health care affects the quality of medical care and health status, depends on the nature of the middle-aged and elderly needs and varies with different ethnic groups [5–10]. The distribution and provision of healthcare resources, the individual's financial ability, and not health-related factors affects healthcare utilization [11–13].

Quality of care was different in urban and rural healthcare organizations [12, 14, 15], and healthcare utilization among middle-aged and elderly in urban and rural was different associated with transportation [12, 14–16].

Many empirical studies has been conducted in the past on accessibility of healthcare and medical care utilization, but most of the researches focused on convenience to healthcare or to investigate the impact of cost burden of the middle-aged and elderly population on the use of healthcare services provided. Only few studies were performed on the relationship between accessibility of healthcare and the utilization of medical care services to the middle-aged and elderly population. In addition, most of the studies investigated with only objective data, few studies used respondents' subjective perceptions to measure access. Our study uses sixth wave of Taiwan Longitudinal Study on Ageing (TLSA) on population above aged 50 and above to explore the relationships of both perceived accessibility and objective time needed in accessing healthcare to utilize medical care services.

Materials and methods

Our study adopts data from sixth wave of Taiwan Longitudinal Study on Ageing (TLSA) which was conducted by the Health Promotion Administration (HPA), Ministry of Health and Welfare. Data including healthcare utilization, health behaviour and health status were collected with face-to-face interview questionnaires. Household registration data of residents aged 50 and above were used as sampling frame for this study.

The dependent variables representing the utilization of medical care services in this study included four types of healthcare utilization: (i) outpatient visits within 1 month, (ii) inpatient administration (hospitalization) within 1 year, (iii) emergency visits within 1 year and (iv) pharmacy stores shopping within 1 year. The variables indicating accessibility of healthcare facilities included perceived convenience in accessing to healthcare facilities, time needed to access to healthcare facilities and having other types of insurance besides National Health Insurance. The relationship between accessibility of healthcare facilities and utilization of medical care services were investigated using univariate and multivariate logistic regression analysis. The odds ratios (OR) and its 95% confidence interval (CI) were reported. Three different settings of multivariate models were applied: (i) Model 1 included all variables for accessibility of healthcare facilities as well as age and gender, (ii) Model 2 included all variables in Model 1 and major health conditions including hypertension, diabetes mellitus, heart disease, stroke, cancer and rheumatoid arthritis, and (iii) Model 3 included variables selected using backward deletion approach where variables did not improved the model fit with $P < 0.05$ were discarded, with all variables for accessibility of healthcare facilities were forced in the model. All statistical analyses were performed with the use of SAS software version 9.2. A two-tailed $P < 0.05$ indicated statistical significance.

Results

Baseline characteristics of study subjects

A total of 4251 subjects responded to this survey and 4249 subjects provided valid questionnaires. The baseline characteristics were shown in Table 1. The gender distributions of study subjects were quite similar between male and female (50.3 vs. 49.7%). Regarding age distributions, the proportions of subjects aged from 50 to 64, from 65 to 74, and 75 years or above, were 40.6, 25.3 and 34.2%, respectively. Most of subjects were married and living with their spouse (67.3%), and more than half (54.2%) took elementary or junior high school education. The majority of subjects were unemployed (48.7%) and 25% of subjects were housekeeper. Regarding health life style behaviours, 17.9% of subjects were current smoker, 28.5% had habitual alcohol consumption, 4.8% had betel nut chewing and 34.1% did not take regular exercise.

Most subjects had one or more chronic disease (71.7%) and 37.5% of subjects had catastrophic illness. The proportions of subjects who had hypertension, diabetes mellitus, heart disease, stroke, cancer, and rheumatoid arthritis were 39.7, 16.7, 18.7, 6.6, 3.6, and 19.0%, respectively. Besides National Health Insurance, which is compulsory insurance in Taiwan, 30.7% had non-commercial insurance and 19.2% had commercial insurance. Regarding time needed to access healthcare facilities, most of subjects spent <30 min to go to nearby hospital (86.1%). Regarding subjectively perceived convenience to access healthcare facilities, 88.3% reported convenient, 8.7% reported inconvenient and 3% reported very inconvenient. The utilization of medical care services analysis has been distributed as, up to 88.6% had outpatient visits within 1 month, 17.3% had been hospitalized within 1 year, 18.1% had emergency visits within 1 year and 33.1% had pharmacy stores shopping within 1 year.

Relationship between accessibility of healthcare facilities and utilization of medical care services

The relationships between accessibility of healthcare facilities and outpatient visits within 1 month investigated by logistic regression were

Table 1 Baseline characteristics of study subjects (*N* = 4249)

Characteristics	N (%)
Gender	
Male	2135 (50.3)
Female	2112 (49.7)
Missing value	2
Age (years)	
50–54	240 (5.7)
55–59	941 (22.2)
60–64	541 (12.7)
65–69	605 (14.3)
70–74	469 (11.0)
75+	1451 (34.2)
Missing value	2
Marital status	
Married	2859 (67.3)
Widowed	1148 (27.0)
Divorced/separated	132 (3.1)
Single	108 (2.5)
Missing value	2
Education	
Illiterate	893 (21.1)
Limited education	193 (4.6)
Elementary or junior high school	2297 (54.2)
High school	475 (11.2)
College or Institute	384 (9.1)
Missing value	7
Occupation	
Unemployed	2066 (48.7)
Housekeeper	1058 (25.0)
Agricultural	548 (12.9)
Non-agricultural	567 (13.4)
Missing value	10
Smoking	
No	3486 (82.1)
Yes	761 (17.9)
Missing value	2
Alcohol consumption	
No	3035 (71.5)
Yes	1212 (28.5)
Missing value	2
Betel nut chewing	
No	4042 (95.2)
Yes	205 (4.8)
Missing value	2
Exercise	
No	1446 (34.1)
Yes	2800 (65.9)
Missing value	3
Self-rated health	
Excellent	379 (8.9)
Good	1072 (25.2)
Moderate	1570 (37.0)
Bad	963 (22.7)
Very bad	263 (6.2)
Missing value	2
ADL	
Without difficulty	2641 (63.5)
With difficulty	1520 (36.5)
Missing value	88
Number of Chronic diseases	
0	1200 (28.3)
1	1152 (27.1)

Table continued

Table 1　Continued

Characteristics	N (%)
2	873 (20.6)
3+	1022 (24.1)
Missing value	2
Catastrophic illness	
No	2655 (62.5)
Yes	1592 (37.5)
Missing value	2
Hypertension	
No	2561 (60.3)
Yes	1686 (39.7)
Missing value	2
Diabetes mellitus	
No	3537 (83.3)
Yes	710 (16.7)
Missing value	2
Heart disease	
No	3452 (81.3)
Yes	795 (18.7)
Missing value	2
Stroke	
No	3965 (93.4)
Yes	282 (6.6)
Missing value	2
Cancer	
No	4095 (96.4)
Yes	152 (3.6)
Missing value	2
Rheumatoid arthritis	
No	3440 (81.0)
Yes	807 (19.0)
Missing value	2
Type of insurance	
NHI only	2127 (50.1)
NHI with other non-commercial insurance	1302 (30.7)
NHI with other commercial insurance	816 (19.2)
Missing value	4
Time interval to access healthcare facilities (min)	
≤30	3609 (86.1)
30< to ≤60	450 (10.7)
60< to ≤90	72 (1.7)
>90	61 (1.5)
Missing value	57
Convenience to access healthcare facilities	
Convenient	3462 (88.3)
Inconvenient	343 (8.7)
Very inconvenient	118 (3.0)
Missing value	326

Non-commercial insurance included public employee insurance, labour insurance, fishery insurance or agricultural insurance.

ADL, activity of daily living.

shown in Table 2. In the univariate analysis, those with commercial insurance were less likely to take outpatient visits within 1 month compared with those without other insurance (OR = 0.71, *P* = 0.005). Those with longer time to access healthcare facilities were more likely to take outpatient visits within 1 month compared with those with only <30 min (>90 vs. ≤30 min, OR = 7.89, *P* = 0.041; 30< to ≤ 60 vs. ≤30 min, OR = 1.72, *P* = 0.004). Under univariate analysis, those perceived inconvenient to access healthcare facilities tended to have higher proportion of outpatient visits within 1 month than those

Table 2 The relationship between accessibility of healthcare facilities and outpatient visits

Accessibility of healthcare facilities	Outpatient visits within 1 month		P-value[†]	Percentage of utilization	Univariate analysis		Multivariate analysis					
	No	Yes			OR (95% CI)	P-value	Model 1[a]		Model 2[b]		Model 3[c]	
	N (%)	N (%)					OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value
Type of insurance												
NHI only	219 (45.4)	1906 (50.7)	0.020	89.61	1.00 (Reference)		1.00 (Reference)		1.00 (Reference)		1.00 (Reference)	
NHI with other non-commercial insurance	149 (30.9)	1153 (30.7)		88.56	0.89 (0.71, 1.11)	0.297	1.06 (0.84, 1.34)	0.602	1.24 (0.98, 1.58)	0.077	1.22 (0.95, 1.56)	0.113
NHI with other commercial insurance	114 (23.7)	702 (18.7)		86.03	0.71 (0.56, 0.90)	0.005	1.16 (0.88, 1.53)	0.287	1.39 (1.04, 1.85)	0.025	1.48 (1.12, 1.95)	0.006
Time interval to access healthcare facilities (min)												
≤ 30	420 (91.7)	3189 (85.4)	0.002	88.36	1.00 (Reference)		1.00 (Reference)		1.00 (Reference)		1.00 (Reference)	
30 < ~ ≤ 60	32 (7.0)	418 (11.2)		92.89	1.72 (1.18, 2.50)	0.004	1.61 (1.10, 2.35)	0.014	1.38 (0.93, 2.04)	0.109	1.30 (0.87, 1.93)	0.199
60 < ~ ≤ 90	5 (1.1)	67 (1.8)		93.06	1.77 (0.71, 4.40)	0.223	1.72 (0.68, 4.32)	0.252	1.34 (0.51, 3.49)	0.555	1.17 (0.45, 3.08)	0.746
> 90	1 (0.2)	60 (1.6)		98.36	7.89 (1.09, 56.98)	0.041	6.33 (0.87, 46.16)	0.069	5.93 (0.80, 43.93)	0.082	4.98 (0.66, 37.35)	0.119
Convenience to access healthcare facilities												
Convenient	413 (92.2)	3049 (87.7)	0.009	88.07	1.00 (Reference)		1.00 (Reference)		1.00 (Reference)		1.00 (Reference)	
Inconvenient	22 (4.9)	321 (9.2)		93.59	1.98 (1.27, 3.08)	0.003	1.48 (0.94, 2.33)	0.090	1.36 (0.85, 2.17)	0.194	1.22 (0.76, 1.97)	0.405
Very inconvenient	13 (2.9)	105 (3.0)		88.98	1.09 (0.61, 1.97)	0.763	0.81 (0.45, 1.48)	0.495	0.65 (0.34, 1.22)	0.175	0.57 (0.28, 1.14)	0.110

OR (95% CI), odds ratio (95% confidence interval).

[†]Chi-square test.

[a]Model 1: type of insurance, time interval to access hospital, convenience to access healthcare facilities, age and gender.

[b]Model 2: not only controlled variables listed in Model 1 but also included hypertension, diabetes mellitus, heart disease, stroke, cancer and rheumatoid arthritis.

[c]Model 3: controlled variables selected by backward deletion approach with significant level 0.05 (gender, education, alcohol consumption, self-rated health, ADL, diabetes mellitus, heart disease, stroke, cancer), type of insurance, time interval to access hospital, convenience to access healthcare facilities were forced in the model (N = 4160).

convenient to access healthcare facilities (inconvenient vs. convenient, OR = 1.98, *P* = 0.003). However, after controlling for confounding variables such as major health conditions (Model 3), subjects with commercial insurance besides National Health Insurance were more likely to take outpatient visits within 1 month compared with those without other insurance (OR = 1.48, *P* = 0.006). Other variables regarding accessibility of healthcare facilities were not significantly associated with outpatient visits within 1 month after controlled for other important variables (Table 2).

The relationships between accessibility of healthcare facilities and hospitalization within 1 year investigated by logistic regression were shown in Table 3. In the univariate analysis, those with other insurance were less likely to have hospitalization within 1 year compared with those without other insurance (commercial vs. no, OR = 0.44, *P* < 0.001; non-commercial vs. no, OR = 0.77, *P* = 0.005). Those with longer time to access healthcare facilities were more likely to have hospitalization within 1 year compared with those with only <30 min (>90 vs. ≤30 min, OR = 2.53, *P* = 0.001; 30< ~ ≤60 vs. ≤30 min, OR = 1.37, *P* = 0.011). Under univariate analysis, those perceived inconvenient to access healthcare facilities tended to have higher proportion of hospitalization within 1 year than those convenient to access healthcare facilities (very inconvenient vs. convenient, OR = 2.56, *P* < 0.001; inconvenient vs. convenient, OR = 1.93, *P* < 0.001). However, after controlling for important confounding variables (Model 3), all three variables regarding accessibility of healthcare facilities were not significantly associated with hospitalization within 1 year (Table 3).

The relationships between accessibility of healthcare facilities and emergency visits within 1 year investigated by logistic regression were shown in Table 4. In the univariate analysis, those with commercial insurance were less likely to have emergency visits compared with those without other insurance (OR = 0.44, *P* = 0.003). Those with longer time to access healthcare facilities were more likely to have emergency visits compared with those with only <30 min (>90 vs. ≤30 min, OR = 1.99, *P* = 0.016; 30< to ≤ 60 vs. ≤30 min, OR = 1.32, *P* = 0.023). Under univariate analysis, those perceived inconvenient to access healthcare facilities tended to have higher proportion of using emergency visits than those convenient to access healthcare facilities (very inconvenient vs. convenient, OR = 2.68, *P* < 0.001; inconvenient vs. convenient, OR = 1.53, *P* = 0.003). However, after controlling for important confounding variables (Model 3), all three variables regarding accessibility of healthcare facilities were not significantly associated with using emergency visits (Table 4).

The relationships between accessibility of healthcare facilities and pharmacy stores shopping within 1 year investigated by logistic regression were shown in Table 5. In the univariate analysis, those with commercial insurance were more likely to shop pharmacy stores compared with those without other insurance (OR = 1.47, *P* < 0.001). Those with longer time to access healthcare facilities were less likely to have pharmacy stores shopping within 1 year compared with those with only <30 min (30< to ≤ 60 min vs. ≤ 30 min, OR = 0.77, *P* = 0.015). Under univariate analysis, those perceived inconvenient to access healthcare facilities were no significant difference in proportion of pharmacy stores shopping compared with those convenient to access healthcare facilities. However, after controlling for important confounding variables (Model 3), those with commercial insurance were more likely to shop pharmacy stores compared with those without other insurance (OR = 1.27, *P* = 0.016), and those with longer time to access healthcare facilities were less likely to shop in pharmacy stores compared with those with only <30 min (>90 vs. ≤30 min, OR = 0.51, *P* = 0.032; 30< to ≤60 vs. ≤30 min, OR = 0.77, *P* = 0.022), and

those were inconvenient to access healthcare facilities were more likely to shop in pharmacy stores than those convenient to access healthcare facilities (inconvenient vs. convenient, OR = 1.49, *P* = 0.002).

In order to make an overall view for the relationship between accessibility of healthcare facilities and utilization of medical care service, the findings from multivariate Model 3 across Tables 2–5 were visualized as Fig. 1.

Discussion

Taiwan's healthcare facilities are considered as abundant because 81.5% of the middle-aged and elderly subjects thought that the medical care is convenient; moreover, 86.1% of the middle-aged and elderly subjects were spent <30 min to reach a healthcare facility. A total of 248 middle-aged and elderly patients reported perceived inconvenient to access healthcare facilities. There was 53.8% of whom reported perceiving inconvenience due to time factor, yet there were only 46.4% of their time needed to access healthcare facilities >60 min. These results show that time is one main factor for perceiving inconvenience. The most common problem of healthcare service reported in a national survey of South African was long waiting time [17]. Past study shows that wealthy people in Spain are willing to pay more for shorter waiting time [18]. The results indicate that time factor does not only refer to time needed to reach a health facility, but also to other areas such as free time of family member to accompany elderly to healthcare facilities and long waiting time.

Our study examined relationships of four types of healthcare utilization (outpatient visits within 1 month, inpatient administration within 1 year, emergency visits within 1 year and pharmacy stores shopping within 1 year) and important variables including age, health status, insurances besides NHI, perceived convenience to healthcare facilities and time needed to access healthcare facilities.

In univariate analyses, the probability of outpatient visits with no commercial insurance was higher than that with any other insurance (*P* < 0.05), and the probability of outpatient visits was higher in patients requiring 31–60 min transportation than that of within 30 min to reach a health facility (*P* < 0.05). Evaluation from a logistic regression analysis shows that time needed to access healthcare facilities and perceived convenience are not statistically significantly related to outpatient visits. Whereas, the number of chronic diseases are significantly related outpatient visits. It indicates that the more the number of chronic diseases relates to the more usage of outpatient visits, and number of chronic diseases is the most important factor.

In contrast to past studies that health insurance increases healthcare utilization [14], the patients with commercial insurance used less hospitalization services. However, this study was conducted in a country that all citizens are covered by NHI. The patients with extra self-paid commercial insurance might indicates better level of economic situation, and might use less medical services. Logistic regression analysis shows that age, number of chronic diseases and time needed to medical care are main factors affecting hospitalization.

Univariate analysis shows that there is a significant relationship between chronic diseases situations and perceived convenience to emergency visits (*P* < 0.05). Logistic regression analysis also shows that age, number of chronic diseases and perceived convenience are the main factors for emergency use. Elderly patients above 75 years of age, with more number of chronic diseases and perceive inconvenient had more emergency visits. Subjects with fewer outpatient visits due to inconvenience might lead to needs of emergency care at a later stage of worsened health.

Table 3 The relationship between accessibility of healthcare facilities and hospitalization

Accessibility of healthcare facilities	Hospitalization within 1 year		P-value[†]	Percentage of utilization	Univariate analysis		Multivariate analysis					
	No	Yes					Model 1[a]		Model 2[b]		Model 3[c]	
	N (%)	N (%)			OR (95%CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value
Type of insurance												
NHI only	1688 (48.2)	437 (59.3)	<0.001	20.55	1.00 (Reference)		1.00 (Reference)		1.00 (Reference)		1.00 (Reference)	
NHI with other non-commercial insurance	1085 (31.0)	217 (29.4)		16.67	0.77 (0.65, 0.93)	0.005	0.93 (0.77, 1.12)	0.462	1.05 (0.87, 1.28)	0.599	1.03 (0.84, 1.26)	0.784
NHI with other commercial insurance	733 (20.9)	83 (11.3)		10.17	0.44 (0.34, 0.56)	< 0.001	0.81 (0.61, 1.07)	0.139	0.91 (0.68, 1.22)	0.541	1.07 (0.81, 1.42)	0.644
Time interval to access healthcare facilities (min)												
≤ 30	3026 (87.0)	583 (81.7)	<0.001	16.15	1.00 (Reference)		1.00 (Reference)		1.00 (Reference)		1.00 (Reference)	
30 < ~ ≤ 60	356 (10.2)	94 (13.2)		20.89	1.37 (1.07, 1.75)	0.011	1.16 (0.90, 1.50)	0.241	1.08 (0.83, 1.40)	0.568	1.01 (0.76, 1.33)	0.957
60 < ~ ≤ 90	55 (1.6)	17 (2.4)		23.61	1.60 (0.93, 2.78)	0.093	1.36 (0.77, 2.41)	0.284	1.15 (0.64, 2.06)	0.637	1.32 (0.72, 2.41)	0.372
> 90	41 (1.2)	20 (2.8)		32.79	2.53 (1.47, 4.35)	0.001	1.93 (1.09, 3.41)	0.024	1.71 (0.95, 3.09)	0.075	1.53 (0.81, 2.89)	0.191
Convenience to access healthcare facilities												
Convenient	2990 (89.6)	472 (80.6)	<0.001	13.63	1.00 (Reference)		1.00 (Reference)		1.00 (Reference)		1.00 (Reference)	
Inconvenient	263 (7.9)	80 (13.7)		23.32	1.93 (1.47, 2.52)	< 0.001	1.26 (0.95, 1.66)	0.112	1.17 (0.88, 1.57)	0.289	0.93 (0.68, 1.27)	0.631
Very inconvenient	84 (2.5)	34 (5.8)		28.81	2.56 (1.70, 3.86)	< 0.001	1.55 (1.01, 2.36)	0.043	1.36 (0.87, 2.11)	0.175	0.92 (0.57, 1.48)	0.719

OR (95% CI), odds ratio (95% confidence interval).

[†]Chi-square test

[a]Model 1: type of insurance, time interval to access hospital, convenience to access healthcare facilities, age and gender.

[b]Model 2: not only controlled variables listed in Model 1 but also included hypertension, diabetes mellitus, heart disease, stroke, cancer and rheumatoid arthritis.

[c]Model 3: controlled variables selected by backward deletion approach with significant level = 0.05 (gender, education, alcohol consumption, self-rated health, ADL, diabetes mellitus, heart disease, stroke, cancer), type of insurance, time interval to access hospital, convenience to access healthcare facilities were forced in the model (N = 4160).

Table 4 The relationship between accessibility of healthcare facilities and emergency service

Accessibility of healthcare facilities	Emergency visits within 1 year		P-value[†]	Percentage of utilization	Univariate analysis		Multivariate analysis					
	No	Yes			OR (95%CI)	P-value	Model 1[a]		Model 2[b]		Model 3[c]	
	N (%)	N (%)					OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value
Type of insurance												
NHI only	1707 (49.1)	418 (54.5)	0.010	19.65	1.00 (Reference)		1.00 (Reference)		1.00 (Reference))		1.00 (Reference)	
NHI with other non-commercial insurance	1074 (30.9)	228 (29.7)		17.51	0.87 (0.73, 1.04)	0.117	0.98 (0.81, 1.18)	0.809	1.08 (0.89, 1.30)	0.435	1.09 (0.90, 1.33)	0.366
NHI with other commercial insurance	695 (20.0)	121 (15.8)		14.83	0.71 (0.57, 0.89)	0.003	1.05 (0.82, 1.36)	0.689	1.17 (0.90, 1.52)	0.233	1.26 (0.99, 1.61)	0.063
Time interval to access healthcare facilities (min)												
≤ 30	2981 (86.8)	628 (83.1)	0.013	17.40	1.00 (Reference)		1.00 (Reference)		1.00 (Reference))		1.00 (Reference)	
30 < ∼ ≤ 60	352 (10.2)	98 (13.0)		21.78	1.32 (1.04, 1.68)	0.023	1.21 (0.95, 1.55)	0.123	1.15 (0.89, 1.47)	0.290	1.14 (0.88, 1.47)	0.335
60 < ∼ ≤ 90	60 (1.8)	12 (1.6)		16.67	0.95 (0.51, 1.78)	0.871	0.86 (0.46, 1.62)	0.636	0.73 (0.38, 1.39)	0.335	0.84 (0.44, 1.61)	0.598
> 90	43 (1.3)	18 (2.4)		29.51	1.99 (1.14, 3.47)	0.016	1.64 (0.92, 2.92)	0.095	1.50 (0.83, 2.71)	0.182	1.41 (0.76, 2.61)	0.272
Convenience to access healthcare facilities												
Convenient	2941 (89.4)	521 (82.4)	<0.001	15.05	1.00 (Reference)		1.00 (Reference)		1.00 (Reference))		1.00 (Reference)	
Inconvenient	270 (8.2)	73 (11.6)		21.28	1.53 (1.16, 2.01)	0.003	1.11 (0.83, 1.47)	0.484	1.02 (0.76, 1.36)	0.896	0.85 (0.63, 1.15)	0.296
Very inconvenient	80 (2.4)	38 (6.0)		32.20	2.68 (1.80, 3.99)	< 0.001	1.89 (1.26, 2.84)	0.002	1.70 (1.12, 2.58)	0.013	1.30 (0.84, 2.02)	0.236

OR (95% CI), odds ratio (95% confidence interval).

[†]Chi-square test.

[a]Model 1: type of insurance, time interval to access hospital, convenience to access healthcare facilities, age and gender.

[b]Model 2: not only controlled variables listed in Model 1 but also included hypertension, diabetes mellitus, heart disease, stroke, cancer and rheumatoid arthritis.

[c]Model 3: controlled variables selected by backward deletion approach with significant level = 0.05 (gender, education, alcohol consumption, self-rated health, ADL, diabetes mellitus, heart disease, stroke, cancer), type of insurance, time interval to access hospital, convenience to access healthcare facilities were forced in the model (N = 4160).

Table 5 The relationship between accessibility of healthcare facilities and pharmacy stores shopping

Accessibility of healthcare facilities	Pharmacy stores shopping within 1 year		P-value†	Percentage of utilization	Univariate analysis		Multivariate analysis					
	No	Yes					Model 1[a]		Model 2[b]		Model 3[c]	
	N (%)	N (%)			OR (95%CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value
Type of insurance												
NHI only	1463 (51.5)	661 (47.1)	<0.001	31.08%	1.00 (Reference)		1.00 (Reference)		1.00 (Reference)		1.00 (Reference)	
NHI with other non-commercial insurance	885 (31.2)	417 (29.7)		32.03	1.04 (0.90, 1.21)	0.579	0.94 (0.80, 1.09)	0.415	0.95 (0.81, 1.11)	0.482	0.97 (0.83, 1.14)	0.738
NHI with other commercial insurance	491 (17.3)	325 (23.2)		39.83	1.47 (1.24, 1.73)	< 0.001	1.12 (0.93, 1.36)	0.241	1.13 (0.93, 1.37)	0.219	1.27 (1.05, 1.54)	0.016
Time interval to access healthcare facilities (min)												
≤ 30	2375 (85.0)	1233 (88.3)	0.027	34.16	1.00 (Reference)		1.00 (Reference)		1.00 (Reference)		1.00 (Reference)	
30 < ~ ≤ 60	322 (11.5)	128 (9.2)		28.44	0.77 (0.62, 0.95)	0.015	0.79 (0.63, 0.98)	0.033	0.78 (0.62, 0.97)	0.027	0.77 (0.61, 0.96)	0.022
60 < ~ ≤ 90	50 (1.8)	22 (1.6)		30.56	0.85 (0.51, 1.41)	0.522	0.79 (0.47, 1.32)	0.364	0.78 (0.47, 1.32)	0.358	0.83 (0.49, 1.41)	0.494
> 90	47 (1.7)	14 (1.0)		22.95	0.57 (0.32, 1.05)	0.070	0.49 (0.27, 0.92)	0.025	0.49 (0.27, 0.92)	0.027	0.51 (0.27, 0.94)	0.032
Convenience to access healthcare facilities												
Convenient	2305 (88.9)	1157 (87.1)	0.246	33.42	1.00 (Reference)		1.00 (Reference)		1.00 (Reference)		1.00 (Reference)	
Inconvenient	214 (8.3)	129 (9.7)		37.61	1.20 (0.96, 1.51)	0.118	1.53 (1.20, 1.95)	0.001	1.49 (1.17, 1.89)	0.001	1.49 (1.17, 1.91)	0.002
Very inconvenient	75 (2.9)	43 (3.2)		36.44	1.14 (0.78, 1.67)	0.495	1.53 (1.03, 2.26)	0.034	1.49 (1.01, 2.21)	0.047	1.47 (0.98, 2.22)	0.064

OR (95% CI): Odds Ratio (95% confidence interval).

†Chi-square test.

[a]Model 1: type of insurance, time interval to access hospital, convenience to access healthcare facilities, age and gender.

[b]Model 2: not only controlled variables listed in Model 1 but also included hypertension, diabetes mellitus, heart disease, stroke, cancer and rheumatoid arthritis.

[c]Model 3: variables selected using backward deletion approach with significant level of stay = 0.05 (age, education, occupation, alcohol consumption, self-rated health, number of chronic disease, diabetes mellitus, heart disease, stroke), but any other type of insurance, time interval to access hospital and convenience to access healthcare facilities were forced in the model (N = 4160).

Accessibility of healthcare facilities

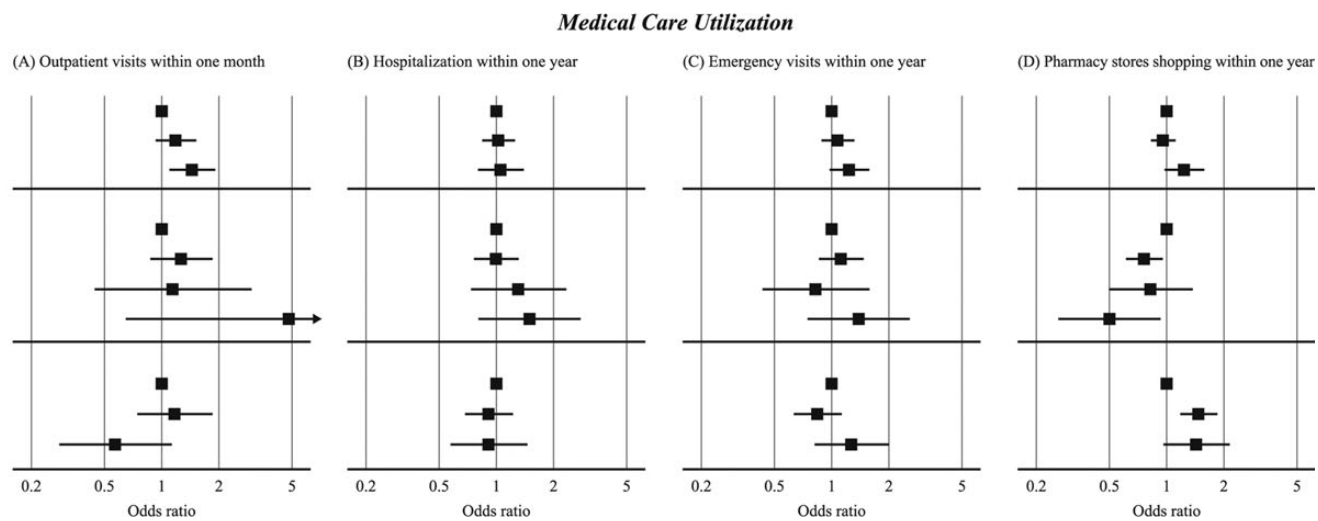*Medical Care Utilization*

Figure 1 The summary plot of multivariate-adjusted odds ratios (Model 3) for the association between accessibility of healthcare facilities and Medicam care utilization with regard to (**A**) outpatient visits within 1 month, (**B**) hospitalization within 1 year, (**C**) emergency visits within one 1 year and (**D**) pharmacy stores shopping within 1 year, respectively. The filled square indicates point estimate of odds ratio, and the error bar indicates 95% confidence interval (CI). The arrow indicates that CI is too wide to show on this plot.

Pharmacy store shopping had significant relationship with age, number of chronic diseases, time needed and perceived convenience to healthcare facilities in univariate analysis. Logistic regression analysis shows that subjects with more number of chronic diseases and those had perceived inconvenience to healthcare facilities shopped pharmacy stores more. This may be due to the fact that since they live far with scarcity in medical resources and tend to buy and take medicines at home.

Multivariate analysis showed commercial insurance were associated with more outpatient visits as well as pharmacy stores shopping; time needed to access healthcare facilities were inversely associated with pharmacy stores shopping; and those perceived inconvenient to access healthcare facilities were more likely to shop pharmacy stores than those perceived convenient. Owing to Taiwan's abundance in healthcare facilities and NHI coverage to everyone, the middle-aged and elderly population tends to seek medical care in all conditions of health which increases the total treatment time and medical expenses.

Our study explores the relationships between accessibility and healthcare utilization by sixth wave of TLSA data. Regarding using national large-scale user experience surveys in local quality improvement, the variation in follow-up and non-standardized research approaches should be well-addressed [19]. We recommend future research can incorporate more TLSA waves for longitudinal analysis. We suggest that governmental agencies can improve accessibility and utilization of medical care by providing better transportation systems in remote areas to reduce the time needed to access healthcare facilities and also decrease the subjects' perceived inconvenience. Scholars has pointed out in the past that rural area residents would have fewer hospital visits due to older and weakened [20]; therefore, the transportation will be increasing important for rural elderly. Recently researches focused on quality of care and area inequity researches include rural area as an important variable for research [15, 21]. We suggest that future study can include urban and rural area into analysis, and also combine the use of quantitative and qualitative data for better investigation and improving accessibility. We believe many of the needs of older people could be addressed through researches, and by systematic efforts to understand their needs and incorporate them into the design of policy will cultivate a better-quality ageing society.

Funding

References

1. Saleh S, Alameddine M, Mourad Y et al. Quality of care in primary health care settings in the Eastern Mediterranean region: a systematic review of the literature. *Int J Qual Health Care* 2015;**27**:79–88.

2. Penchansky R, Thomas JW. The concept of access: definition and relationship to consumer satisfaction. *Med Care* 1981;**19**:127–40.

3. Andersen RM. Revisiting the behavioral model and access to medical care: does it matter? *J Health Soc Behav* 1995;**36**:1–10.

4. Sloan FA. Access to medical care and the local supply of physicians. *Med Care* 1977;**15**:338–46.

5. Anand S, Bärnighausen T. Human resources and health outcomes: cross-country econometric study. *Lancet* 2004;**364**:1603–9.

6. Dutt AK, Dutta HM, Jaiswal J et al. Assessment of service adequacy of primary health care physicians in a two county region of Ohio, USA. *GeoJournal* 1986;**12**:443–55.

7. Goodman DC, Fisher ES, Little GA et al. The relation between the availability of neonatal intensive care and neonatal mortality. *N Engl J Med* 2002;**346**:1538–44.

8. Newhouse JP, Friedlander LJ. The relationship between medical resources and measures of health: some additional evidence. *J Hum Resour* 1980 Winter;**15**:200–18.

9. McConnell YJ, Inglis K, Porter GA. Timely access and quality of care in colorectal cancer: are they related? *Int J Qual Health Care* 2010;**22**:219–28.

10. Hsiao YY, Cheng SH. Is there a disparity in the hospital care received under a universal health insurance program in Taiwan? *Int J Qual Health Care* 2013;**25**:232–8.

11. Pu C, Huang N, Tang G-J et al. When does poor subjective financial position hurt the elderly? Testing the interaction with educational attainment using a national representative longitudinal survey. *BMC Public Health* 2011;**11**:166.

12. Teng Y-H, Teng J-J, Lee M-Y et al. Determinants of emergency medical utilization among the elderly population in Taiwan: a national longitudinal cohort study. *Arch Gerontol Geriatr* 2013;**56**:364–9.

13. Walter-Ginzburg A, Chetrit A, Medina C et al. Physician visits, emergency room utilization, and overnight hospitalization in the old–old in Israel: the Cross-Sectional and Longitudinal Aging Study (CALAS). *J Am Geriatr Soc* 2001;**49**:549–56.

14. Liao PA, Chang HH, Yang FA. Does the universal health insurance program affect urban-rural differences in health service utilization among the elderly? Evidence from a longitudinal study in Taiwan. *J Rural Health* 2012;**28**:84–91.

15. Lutfiyya MN, Bhat DK, Gandhi SR et al. A comparison of quality of care indicators in urban acute care hospitals and rural critical access hospitals in the United States. *Int J Qual Health Care* 2007;**19**:141–9.

16. Winters S, Kool RB, Klazinga NS et al. The influence of corporate structure and quality improvement activities on outcome improvement in residential care homes. *Int J Qual Health Care* 2014;**26**:378–87.

17. Hasumi T, Jacobsen KH. Healthcare service problems reported in a national survey of South Africans. *Int J Qual Health Care* 2014;**26**:482–9.

18. Borrell C, Fernandez E, Schiaffino A et al. Social class inequalities in the use of and access to health services in Catalonia, Spain: what is the influence of supplemental private health insurance? *Int J Qual Health Care* 2001;**13**:117–25.

19. Haugum M, Danielsen K, Iversen HH et al. The use of data from national and other large-scale user experience surveys in local quality work: a systematic review. *Int J Qual Health Care* 2014;**26**:592–605.

20. Iezzoni LI, Davis RB, Soukup J et al. Satisfaction with quality and access to health care among people with disabling conditions. *Int J Qual Health Care* 2002;**14**:369–81.

21. Bradley E, Thompson JW, Byam P et al. Access and quality of rural healthcare: Ethiopian Millennium Rural Initiative. *Int J Qual Health Care* 2011; doi:10.1093/intqhc/mzv013.