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Difference in frequency and outcome of geriatric emergency department utilization between urban and rural areas

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Abstract

Background: Elderly people are susceptible to develop multiple chronic diseases and are thus likely to utilize the emergency department (ED). Access to health care and health outcomes may differ between rural and urban areas. This study aims to compare the frequency and outcome of geriatric ED utilization between urban and rural areas.

Methods: This population-based study obtained information from the health insurance database. The frequency and outcome of ED utilization in 2013 were compared among people aged ≥65 years living in urban and rural areas. The independent effect of various characteristics on the frequency and outcome of ED utilization was evaluated using multivariate logistic regression analysis.

Results: Of the 6695 people living in urban areas, 1879 (28.07%) utilized the ED and accounted for 3859 ED visits. Meanwhile, 908 (29.75%) of the 3052 people living in rural areas utilized the ED and accounted for 1820 ED visits. No difference in the prevalence of ED utilization was found between the urban and rural areas. Urbanization did not affect the risk of frequent ED utilization among ED users. People living in rural areas had an increased risk of ED visits with a high acuity (adjusted odds ratio: 1.40, 95% CI: 1.12-1.75). Urbanization did not affect the risk of hospitalization or immediate death after ED visits.

Conclusion: The frequency of ED utilization showed no urban-rural difference. Elderly people living in rural areas had an increased risk of visiting the ED with a high acuity.

Keywords: Hospitalization; Multiple chronic diseases; Urbanization

1. INTRODUCTION

Population ages rapidly. About 13% of the people in the UK, USA, and Australia in 2009 were >65 years old. This proportion is expected to increase to 25% over the next 25 years, with the proportion of those aged >85 years rising from 1.5% to 5%.[1–3] Elderly people are susceptible to develop chronic diseases and multiple comorbidities[4] and are thus likely to utilize the emergency department (ED).[5] Previous studies reported that old people use the ED as a healthcare source.[6–8] In addition, a growing percentage of frequent ED users are aged >65 years, and this rate is increasing.[9] Old people constitute up to 20% of all ED encounters, are more likely to have repeat visits to the ED, and are more likely to be admitted to the hospital than young people.[10]

Rural-urban differences in health remain a concern worldwide. Previous studies reported that urban and rural areas differ in access to and outcome of health care.[11,12] A previous study evaluated the impact of a universal health insurance program on urban–rural differences in health service utilization among the elderly and found that the universal health insurance program in Taiwan yields differential impacts on health service utilization across different areas. The rural elderly may need to fight against challenges in accessing health care associated with spatial distance, transportation, social isolation, poverty, and a lack of healthcare providers, especially medical specialists.[11] Chen et al.[12] reported that the rural-urban disparity in receiving recommended diabetes care diminished from 2000 to 2010, but significant gaps between rural and urban areas in avoidable hospitalizations for diabetes persisted despite the universal health system in Taiwan.

Elderly people residing in rural areas experience poorer health and greater mortality compared with those residing in urban areas because of barriers that impede access to primary health care.[13] Thus, the ED is likely utilized for nonemergent conditions when other primary healthcare services are unobtainable.[6,7] One study in Canada reported that Medicare beneficiaries living in isolated rural settings have a lower rate of follow-up care than urban beneficiaries and that beneficiaries in large and small rural settings have a greater risk of an ED visit compared with urban beneficiaries.[8]

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Compared with young people, elderly people are more likely to be frequent ED users and to have worse outcome.[14] Access to and outcome of health care differ between urban and rural areas.[11,12] Poor access to ordinary care may increase the demand of ED utilization and adversely influence the outcome of ED visits, such as the acuity of ED visits and hospitalization after ED visits. Few studies compared the frequency of ED utilization and outcome of ED visits between elderly people living in urban and rural areas. Thus, the present study compared the frequency of ED utilization, acuity of ED visits, hospitalization after ED visits, and deaths after ED visits between geriatric people living in urban and rural areas.

2. METHODS

2.1. Study design and data source

This population-based cross-sectional study obtained data from the National Health Insurance Research Database (NHIRD), which is maintained by the National Health Research Institutes (NHRI). Taiwan's National Health Insurance (NHI) is a universal public health insurance program implemented in 1995. NHI is operated under a governmental organization, the Bureau of NHI (BNHI), and it is funded through a combination of premiums and taxes.[15] The NHI program covered 99.0% of the population by 2004 and 99.5% of the population by 2010.[16] The NHIRD can be accessed by scientists in Taiwan for research purposes. For privacy protection, NHIRD data that can be used to recognize patients or care providers, including medical institutions and physicians, are encrypted before delivery to the NHRI for database composition. Data are further scrambled before provision to each researcher. Therefore, individual patient or healthcare providers cannot be recognized from the database.[17]

NHIRD contains "cohort datasets," including claims data randomly sampled, in 2000, 2005, and 2010, from all beneficiaries. The purpose of cohort datasets is to follow-up a representative group of the population longitudinally.[18] In the present study, we used longitudinal health insurance database 2010 (LHID2010). LHID2010 contains all registry and claim data of 1 million people randomly sampled in the year 2010. The registration data of about 27.38 million people who were beneficiaries of the NHI program during January 1, 2010, to December 31, 2010, were drawn for random sampling. New claims data of the cohort would be released every year. According to NHIRD, the patients in the LHID2010 and the original NHIRD showed no significant difference in gender distribution.[19]

After approval from the institution review board of Taipei City Hospital and ethical approval from the NHRI, all of the ambulatory care claims (2012–2013), inpatient claims (2012–2013), and the updated registry for beneficiaries (2013) were used in this study. The ambulatory care expenditure by visit (ACEV) files provide information on the date of visit, up to three diagnoses, encrypted identification numbers of both the patients and the attending physicians, patient sex, and birth date. In addition, the ACEV files provide codes of the physician fees for emergency care, which can be used to recognize ED visits. Using the encrypted individual personal identification number, we were able to link all the datasets.[14]

2.2. Selection of the study participants and measurements

All people aged ≥65 years were analyzed to compare the frequency of ED utilization and outcome of ED visits, including acuity of ED visits, hospitalization after ED visits, and death after ED visits, between old people living in urban and rural areas. For the frequency of ED visits, we divided all ED users in 2013 into nonfrequent ED users (ED visits one to three times), frequent ED users (ED visits four to 12 times), or highly frequent ED users (ED visits >12 times) after considering the characteristics of different levels of frequent ED users. The acuity of ED visits was evaluated with the Taiwan Triage and Acuity Scale (TTAS), which is a computerized triage system implemented in 2010. TTAS was developed by the Taiwan Society of Emergency Medicine and Taiwan Association of Critical Care Nurses on the basis of the framework of the Canadian Triage and Acuity Scale. TTAS is a five-level ED triage classifying patients in descending order of acuity, that is, level 1, resuscitation; level 2, emergent; level 3, urgent; level 4, less urgent; and level 5, non-urgent.[20] In the present study, an ED visit triaged as level 1, 2, or 3 would be defined as high acuity and an ED visit triaged as level 4 or 5 would be defined as low acuity.

For evaluating the urbanization of residential areas, we followed the classification proposed by Liu et al. that categorized the urbanization of individual areas into seven levels after

Table 1

Characteristics of geriatric people according to urbanization of residential area

	All	Urban	Rural	*p*
Variables	**n (%)**	**n (%)**	**n (%)**	
Total	9747 (100)	6695 (100)	3052 (100)	
Age, y				<0.0001
65-74	5217 (53.52)	3718 (55.53)	1499 (49.12)	
75-84	3497 (35.88)	2245 (33.53)	1252 (41.02)	
≧85	1033 (10.60)	732 (10.93)	301 (9.86)	
Gender				0.5697
Female	5279 (54.16)	3639 (54.35)	1640 (53.74)	
Male	4468 (45.84)	3056 (45.65)	1412 (46.26)	
Welfare				0.5839
No	9633 (98.83)	6614 (98.79)	3019 (98.92)	
Yes	114 (1.17)	81 (1.21)	33 (1.08)	
OPD visits ≧30 times in previous 1 y				0.9965
No	4161 (42.69)	2858 (42.69)	1303 (42.69)	
Yes	5586 (57.31)	3837 (57.31)	1749 (57.31)	
Hospitalization in previous 1 y				<0.0001
No	8139 (83.50)	5673 (84.73)	2466 (80.80)	
Yes	1608 (16.50)	1022 (15.27)	586 (19.20)	
CCI				0.1790
0	3480 (35.70)	2431 (36.31)	1049 (34.37)	
1-2	4405 (45.19)	2996 (44.75)	1409 (46.17)	
≧3	1862 (19.10)	1268 (18.94)	594 (19.46)	

CCI = Charlson comorbidity index; OPD = outpatient department.

Table 2

Utilization of ED according to urbanization of residential area

	All	Urban	Rural	*p*
	n (%)	n (%)	n (%)	
Total	9747 (100)	6695 (100)	3052 (100)	
No	6960 (71.41)	4816 (71.93)	2144 (70.25)	0.0933
Yes	2787 (28.59)	1879 (28.07)	908 (29.75)	
Total ED visits	5679	3859	1820	
Mean ED visits	2.038	2.054	2.004	0.6025

ED = emergency department.

considering population density, proportion of people with education of college or above, proportion of elderly people aged ≥65 years, proportion of agriculture workers, and the number of physicians per 100 000 people. The seven levels of urbanization includes, in decreasing order of urbanization, highly urbanized towns, moderately urbanized towns, emerging towns, general towns, aging towns, agricultural towns, and remote towns.[21] In the present study, we excluded subjects with a registered residential area in emerging towns or general towns. We categorized subjects with a registered residential area in highly urbanized towns or moderately urbanized towns as living in an urban area, and those with a registered residential area in aging towns, agricultural towns, or remote towns were categorized as living in a rural area.

For considering medical care cross-over area, we followed the principle by Lin et al.[22] and included only subjects with a medical care record for upper respiratory tract infection in 2013 in a medical facility located in the area identical to the registered residential area of the subjects.

The age of each study subject was calculated by the difference in time between the date of the first ED visit and the date of birth. The status of receiving welfare was identified from an updated registry of the beneficiaries. The numbers of outpatient department (OPD) visits and hospitalizations a year before the first ED visit were calculated to evaluate the pattern of medical care utilization. Hsu et al.[23] reported that the average number of medical care visits for people aged ≥65 years in Taiwan was 28.54 in 2010. Accordingly, we categorized subjects with OPD visits ≥30 times in the previous year as those with high OPD utilization. We evaluated the individuals' comorbidities included in the Charlson comorbidity index, which considers 19 predetermined clinical conditions and is a strong predictor of various adverse clinical outcomes.[24] We searched the ACEV files of 2012 to 2013 and counted these comorbidities only when the subjects had at least three outpatient visits with the diagnosis a year before the first ED visit.

2.3. Statistical analysis

Descriptive statistical analysis was used to demonstrate the difference in characteristics between subjects living in urban and rural areas. We used multivariate logistic regression to investigate the independent effects of urban-rural difference; various patient characteristics, including age, gender, and welfare; utilization of other healthcare resources, and comorbidities on the frequency of ED utilization, acuity of ED visits, hospitalization after ED visits, and death after ED visits. All statistical analyses were performed using SAS statistical software (version 9.4; SAS institute, Cary, NC). Statistical significance was considered at $p < 0.05$.

Table 3

Factors associated with frequent emergency department visits

	Emergency department visits 4-12 times		Emergency department visits >12 times	
	AOR[a]	95% CI	AOR[a]	95% CI
Urbanization				
Urban	1		1	
Rural	0.85	0.65-1.11	1.18	0.48-2.91
Age, y				
65-74	1		1	
75-84	1.38	1.04-1.82	0.83	0.31-2.26
≧85	1.44	1.01-2.05	1.65	0.57-4.73
Gender				
Female	1		1	
Male	1.16	0.90-1.49	1.38	0.58-3.27
Welfare				
No	1		1	
Yes	2.63	1.39-5.00	...	...
OPD visits ≧30 times in previous 1 y				
No	1		1	
Yes	1.67	1.20-2.33	1.75	0.49-6.25
Hospitalization in previous 1 y				
No	1		1	
Yes	1.69	1.30-2.22	2.78	1.15-6.67
CCI				
0	1		1	
1-2	1.21	0.84-1.76	2.97	0.36-24.76
≧3	2.07	1.40-3.05	8.09	0.99-66.19

AOR = adjusted odds ratio; CCI = Charlson comorbidity index; OPD = outpatient department.

[a] Estimated from multivariate logistic regression with urbanization, age, gender, welfare, OPD visits ≧30 times in previous 1 y, hospitalization in previous 1 y, and CCI simultaneously included in the model.

3. RESULTS

Table 1 demonstrates the characteristics of geriatric people living in urban and rural areas. The total number of subjects was 9747, of which 6695 lived in urban areas and 3052 lived in rural areas. Compared with people in urban areas, there were a higher proportion of people aged 75 to 84 years in rural areas. There were a higher proportion of people hospitalized in the previous year in rural areas.

Of the 6695 subjects living in urban areas, 1879 (28.07%) utilized the ED and accounted for 3859 ED visits in 2013. Of the 3052 subjects living in rural areas, 908 (29.75%) utilized the ED and accounted for 1820 ED visits in 2013. The prevalence of ED utilization did not significantly differ between subjects living in urban and rural areas. The mean number of ED visits among ED users also did not significantly differ between subjects living in urban and rural areas (Table 2).

Table 3 demonstrates the factors associated with frequent ED visits or highly frequent visits among ED users. Urbanization did not affect the risk of frequent ED utilization or highly frequent ED utilization among ED users. Compared with subjects aged 65 to 74 years, those aged 75 to 84 years and ≧85 years were more likely to be frequent ED users. Welfare and OPD visits ≧30 times in the previous year increased the risk of frequent ED utilization. Hospitalization in the previous year increased the risk of frequent and highly frequent ED utilization. Compared with CCI = 0, CCI ≧ 3 increased the risk of frequent ED utilization.

Table 4 demonstrates the outcome of the first ED visit among ED users in 2013 according to the urbanization of residential areas. Compared with subjects in rural areas, a higher proportion of subjects in urban areas visited the ED of a medical center and a higher proportion of people in rural areas visited the ED of a district hospital. The proportions of triage acuity scales 1, 2, 3, 4, and 5 for urban areas were 2.51%, 13.21%, 60.82%, 13.50%, and 1.14%, respectively, and the corresponding figures for rural areas were 2.00%, 10.35%, 62.35%, 14.24%, and 0.47%, respectively. The proportions of hospitalization after ED visits for urban and rural areas were 20.73% and 18.35%, respectively. The proportions of death after ED visits for urban and rural areas were 1.37% and 1.06%, respectively.

Table 4

Outcome of the first ED visit for ED user according to urbanization of residential area

	All	Urban	Rural	*p*
Variables	**n[a] (%)**	**n[a] (%)**	**n[a] (%)**	
Total	2606 (100)	1756 (100)	850 (100)	
Age, y				
65-74	1114 (42.75)	772 (43.96)	342 (40.24)	0.0308
75-84	1076 (41.29)	694 (39.52)	382 (44.94)	
≧85	416 (15.96)	290 (16.51)	126 (14.82)	
Gender				0.2860
Female	1336 (51.27)	913 (51.99)	423 (49.76)	
Male	1270 (48.73)	843 (48.01)	427 (50.24)	
Welfare				0.3305
No	2553 (97.97)	1717 (97.78)	836 (98.35)	
Yes	53 (2.03)	39 (2.22)	14 (1.65)	
OPD[a] visits ≧30 times in previous 1 y				0.2073
No	870 (33.38)	572 (32.57)	298 (35.06)	
Yes	1736 (66.62)	1184 (67.43)	552 (64.94)	
Hospitalization in previous 1 y				0.0082
No	1913 (73.41)	1317 (75.00)	596 (70.12)	
Yes	693 (26.59)	439 (25.00)	254 (29.88)	
CCI[a]				0.7877
0	665 (25.52)	452 (25.74)	213 (25.06)	
1-2	1197 (45.93)	810 (46.13)	387 (45.53)	
≧3	744 (28.55)	494 (28.13)	250 (29.41)	
Hospital accreditation				<0.0001
Medical center	726 (27.86)	647 (36.85)	79 (9.29)	
Regional hospital	1293 (49.62)	869 (49.49)	424 (49.88)	
District hospital	587 (22.52)	240 (13.67)	347 (40.82)	
Diagnosis				0.0557
Trauma	535 (20.53)	342 (19.48)	193 (22.71)	
Nontrauma	2071 (79.47)	1414 (80.52)	657 (77.29)	
Triage acuity scale				0.0889
Level 1	61 (2.34)	44 (2.51)	17 (2.00)	
Level 2	320 (12.28)	232 (13.21)	88 (10.35)	
Level 3	1598 (61.32)	1068 (60.82)	530 (62.35)	
Level 4	358 (13.74)	237 (13.50)	121 (14.24)	
Level 5	24 (0.92)	20 (1.14)	4 (0.47)	
Others	245 (9.40)	155 (8.83)	90 (10.59)	
Hospitalization after ED visits				0.1548
No	2086 (80.05)	1392 (79.27)	694 (81.65)	
Yes	520 (19.95)	364 (20.73)	156 (18.35)	
Death after ED visits				0.5099
No	2573 (98.73)	1732 (98.63)	841 (98.94)	
Yes	33 (1.27)	24 (1.37)	9 (1.06)	

CCI = Charlson comorbidity index; ED = emergency department; OPD = outpatient department.

[a]The inclusion period of first ED visit was from January 1 to November 30 because we define death after ED visits as withdraw from the National Health Insurance program in 1 month after ED visits. As a result, the number of the first ED visits was less than the number of ED users in 2013.

Table 5

Factors associated with high acuity of emergency department visits, N = 2606

	OR	95% CI	AOR[a]	95% CI
Urbanization				
Urban	1		1	
Rural	0.91	0.75-1.10	1.40	1.12-1.75
Age, y				
65-74	1		1	
75-84	1.21	0.99-1.47	1.19	0.97-1.46
≧85	1.17	0.90-1.52	1.12	0.85-1.48
Gender				
Female	1		1	
Male	1.09	0.91-1.31	1.08	0.90-1.31
Welfare				
No	1		1	
Yes	0.72	0.40-1.32	0.80	0.43-1.49
OPD[a] visits ≧30 times in previous 1 y				
No	1		1	
Yes	1.01	0.83-1.22	1.02	0.83-1.27
Hospitalization in previous 1 y				
No	1		1	
Yes	0.95	0.78-1.16	0.84	0.67-1.05
CCI[a]				
0	1		1	
1-2	0.99	0.80-1.24	1.00	0.78-1.26
≧3	1.14	0.89-1.46	1.14	0.86-1.52
Accreditation level of the hospital				
Medical center	1		1	
Regional hospital	1.29	1.02-1.63	1.21	0.96-1.54
District hospital	0.31	0.24-0.40	0.27	0.20-0.35
Diagnosis				
Trauma	1		1	
Nontrauma	1.23	0.99-1.52	1.13	0.90-1.42

AOR = adjusted odds ratio; CCI = Charlson comorbidity index; OPD = outpatient department.

[a]Estimated from multivariate logistic regression with urbanization, age, gender, welfare, OPD visits ≧30 times in previous 1 y, hospitalization in previous 1 y, CCI, accreditation level of the hospital, and diagnosis simultaneously included in the model.

The independent effect of individual characteristics on the triage acuity of ED visits is demonstrated in Table 5. Subjects living in rural areas had an increased risk of ED visits with a high acuity.

Table 6 illustrates the factors associated with hospitalization or immediate death after ED visits. Urbanization did not significantly affect the risk of hospitalization after ED visits. Compared with subjects aged 65 to 74 years, those aged 75 to 84 years and ≧85 years had a higher risk of hospitalization after ED visits. Compared with subjects visiting the ED of a medical center, those visiting the ED of a district hospital were less likely to be hospitalized after ED visits. Compared with subjects visiting the ED with a diagnosis of trauma, those visiting the ED with a diagnosis of nontrauma had a higher risk of hospitalization after ED visits. ED visits with a high acuity increased the risk of hospitalization after ED visits. With regard to the risk of immediate death after ED visits, urbanization did not significantly affect the risk of death after ED visits. Compared with subjects aged 65 to 74 years, those aged ≧85 years had a higher risk of death after ED visits. Compared with subjects visiting the ED with a diagnosis of trauma, those visiting the ED with a diagnosis of nontrauma had a higher risk of death after ED visits. ED visits with a high acuity increased the risk of death after ED visits.

4. DISCUSSION

In the present study, the prevalence of ED utilization did not significantly differ between subjects living in urban and rural areas. The mean number of ED visits did not significantly differ among ED users between subjects living in urban and rural areas. Urbanization did not increase the risk of frequent ED utilization. Subjects living in rural areas had an increased risk of ED visits with a high acuity. Urbanization did not significantly affect the risk of hospitalization and death after ED visits.

The frequency of ED utilization did not significantly differ between subjects living in urban and rural areas. Rural residents often have limited access to local healthcare providers and hospitals, which may affect their use of essential health services.[6,7] If other primary healthcare services are unobtainable, elderly people living in rural areas may visit the ED as a source of medical care and have a higher rate of ED utilization. However, previous studies on urban-rural difference in the frequency of ED utilization reported inconsistent results. Using the data of the Medicare Current Beneficiary Survey, Cost and Use files from 2000 to 2010, one study in North Carolina reported that Medicare beneficiaries living in isolated rural settings have a lower rate of follow-up care after discharge and beneficiaries in large and small rural settings have a greater risk of an ED visit compared with urban beneficiaries.[8] Meanwhile, Lishner et al. compared ED utilization among Medicare beneficiaries in Washington State in 1994 by using the data of The U.S. Health Care Financing Administration's National Claims File. The authors reported that elderly people living in remote areas are 13% less likely to visit the ED than their urban counterparts.[6]

The present study revealed that compared with elderly people living in urban areas, those living in rural areas had a higher risk of ED visits with a high acuity. Rural residents often have limited access to local healthcare providers and hospitals, which may affect their use of essential health services. Previous research demonstrated lower use of ambulatory care services by elderly people living in rural areas as compared with their urban counterparts largely because of poor access and a limited supply of local providers.[25] One study in Taiwan reported that the universal health insurance program yields differential impacts on

Table 6

Factors associated with hospitalization or immediate death after emergency department visits, N = 2606

	Risk of hospitalization				Risk of immediate death			
Variables	**OR**	**95% CI**	**AOR[a]**	**95% CI**	**OR**	**95% CI**	**AOR[a]**	**95% CI**
Urbanization								
Urban	1		1		1		1	
Rural	0.86	0.70-1.06	0.97	0.77-1.22	0.77	0.36-1.67	0.84	0.36-1.97
Age, y								
65-74	1		1		1		1	
75-84	1.52	1.22-1.88	1.45	1.17-1.81	1.04	0.45-2.40	1.00	0.43-2.34
≧85	1.63	1.24-2.15	1.49	1.12-1.99	2.72	1.17-6.33	2.41	1.02-5.71
Gender								
Female	1		1		1		1	
Male	1.06	0.87-1.28	0.99	0.81-1.20	1.43	0.72-2.87	1.33	0.66-2.69
Welfare								
No	1		1		1		1	
Yes	0.93	0.47-1.85	0.96	0.47-1.96	1.52	0.20-11.11	1.52	0.20-11.11
OPD[a] visits ≧30 times in previous 1 y								
No	1		1		1		1	
Yes	1.22	0.99-1.49	1.02	0.81-1.28	0.77	0.38-1.56	0.68	0.32-1.45
Hospitalization in previous 1 y								
No	1		1		1		1	
Yes	1.32	1.08-1.64	1.16	0.93-1.47	1.20	0.57-2.56	1.16	0.53-2.56
CCI[a]								
0	1		1		1		1	
1-2	1.29	1.01-1.66	1.14	0.87-1.48	1.87	0.75-4.67	1.77	0.68-4.60
≧3	1.60	1.23-2.10	1.33	0.99-1.80	1.04	0.35-3.12	0.98	0.30-3.22
Hospital accreditation								
Medical center	1		1		1		1	
Regional hospital	0.90	0.73-1.12	0.91	0.72-1.14	0.70	0.33-1.50	0.72	0.33-1.60
District hospital	0.49	0.37-0.66	0.64	0.46-0.88	0.61	0.23-1.65	1.01	0.34-3.05
Diagnosis								
Trauma	1		1		1		1	
Nontrauma	2.99	2.19-4.10	2.79	2.03-3.83	8.44	1.15-61.93	7.58	1.03-55.90
Acuity								
Low acuity	1		1		1		1	
High acuity	2.39	1.82-3.13	2.14	1.61-2.84	4.97	1.19-20.84	5.15	1.20-22.09

AOR = adjusted odds ratio; CCI = Charlson comorbidity index; OPD = outpatient department.

[a] Estimated from multivariate logistic regression with urbanization, age, gender, welfare, OPD visits ≧30 times in previous 1 y, hospitalization in previous 1 y, CCI, accreditation level of the hospital, diagnosis, and acuity simultaneously included in the model.

health service utilization between elderly people living in urban and rural areas. The authors argued that compared with urban elderly, rural elderly may experience more challenges in accessing health care associated with spatial distance, transportation, social isolation, poverty, and a lack of healthcare providers, especially medical specialists.[11] Another study on rural-urban differences in receiving guideline-recommended diabetes care and avoidable hospitalizations under a universal coverage health system reported that rural-urban disparity in receiving recommended diabetes care diminished from 2000 to 2010; however, significant gaps between rural and urban areas in avoidable hospitalizations for diabetes persisted despite the universal health system in Taiwan.[12] The authors argued that rural-dwelling people might have a lower perceived value of medication adherence than their urban counterparts[26] and that rural residents are more likely to experience barriers to receiving diabetes education programs that support patients' engagement in self-care.[27] In addition to limited access to local healthcare providers and hospitals in rural areas, inadequate health literacy and adherence to physicians' suggestions via self-care programs may increase the risk of poor health outcome, such as visiting the ED with a high acuity.

Rural-urban disparity in access to primary care raises the concern of poor outcomes of health care. In the present study, urbanization did not significantly affect the risk of hospitalization and death after ED visits. Previous studies found that patients living in rural areas have a higher risk to avoidable hospitalization.[28,29] Thorpe et al. studied rural-urban differences in preventable hospitalizations among community-dwelling veterans with dementia and found that dementia patients living in the most rural counties are more likely to have an ambulatory care-sensitive hospitalization and that dementia patients in rural areas may face particular challenges in receiving timely, effective ambulatory care.[28] Some studies reported that the mortality of certain diseases is not different between rural and urban residents.[30,31] In the study on mortality and revascularization following admission for acute myocardial infarction, Abrams et al.[31] reported that rural veterans admitted for acute myocardial infarction care have a similar risk of 30-day mortality.

The present study has several methodological strengths. First, nationwide insurance claims data allow easy access to the longitudinal records of a large sample of geographically scattered patients and increase the representativeness of the study sample. Second, the NHI dataset provided accurate information on ED utilization and destination after ED visits, which reduced the recall bias. Several study limitations need to be addressed. First, using linked administrative data, we had insufficient information about presenting symptoms and clinical courses during the ED visits, which may confound the study results. Second, we lacked information on some patient characteristics, such as education, health literacy, and socioeconomic status, which could be vital for the interpretation of study results. In the present study, we used the status of welfare as a surrogate of socioeconomic status, but it may not accurately represent the socioeconomic status of the patients. Third, we used the claims data of 2013, which may have limited the case number. Enrollment of patients in a longer period could increase the case numbers and analyze

the year trend. Fourth, the difference in NHI enrollment between elderly people living in rural and urban areas may confound the association of urbanization with the frequency of ED utilization. However, the NHI program covered 99.5% of the population by 2010,[16] and the enrollment rate between elderly people living in rural and urban areas is unlikely to significantly differ.

In the present study, the prevalence of ED utilization and the risk of frequent ED utilization showed no urban-rural difference. However, compared with elderly people living in urban areas, those living in rural areas had an increased risk of ED visits with a high acuity. In addition to the issue of access to healthcare facilities in rural areas, health literacy promotion, including health education to improve health knowledge and adherence to self-care programs, may be helpful to diminish urban-rural disparity in the outcome of health care.

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