Hospitalization for Respiratory Tract Infections Increases the Use of Medical Care and Long-Term Care Services

A Pre-Post Assessment Adopting a Difference-in-Differences Analysis on LIFE Study Data

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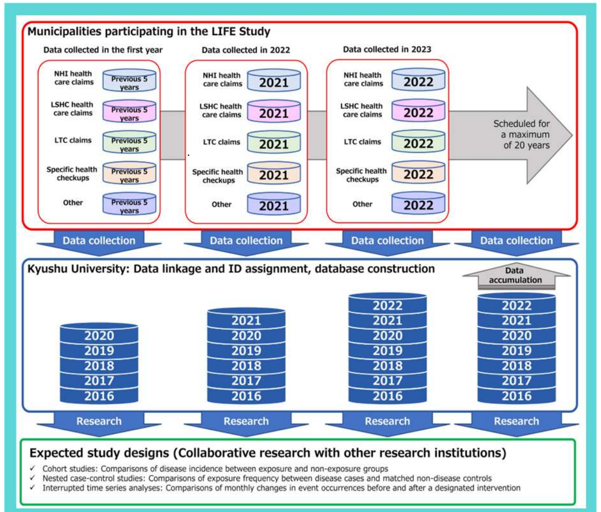
About the LIFE Study

The Longevity Improvement & Fair Evidence (LIFE) Study, which was launched in 2019, is a multi-region community-based database project managed by Kyushu University (Fukuoka, Japan) that aims to generate evidence toward extending healthy life expectancy and reducing health disparities in Japan. Municipalities participating in the LIFE Study provide data from government-administered health insurance enrollees and public assistance recipients. The database collects healthcare claims data, long-term care claims data, health checkup data, vaccination records, residence-related information, and income-related information. The various data types are linked using a unique common data format.



Overview of the LIFE Study design
Abbreviations: LSHC, Latter-Stage Older Persons Health Care System; LTC, long-term care; NHI, National Health Insurance.

The LIFE Study compiles the collected data into datasets, which are provided to research groups for analysis. Before these datasets are delivered, the institution(s) of each research group must enter into data utilization agreements and submit data operation regulations to Kyushu University. There are also measures to ensure that the research groups use the data in accordance with these agreements and regulations.

Fukuda H, et al.
The Longevity Improvement & Fair Evidence (LIFE) Study: Overview of the Study Design and Baseline Participant Profile.
J Epidemiol. 2023;33(8):428-37. DOI: 10.2188/jea.JE20210513

Our work on the LIFE Study
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Background

Respiratory tract infections (RTIs) are expected to impose an increasingly heavy socioeconomic burden in the future, as most developed countries are or will be facing the problem of population aging. However, few studies have addressed the disease burden of RTIs [1,2].

To quantify the socioeconomic burden of RTIs, we described the changes in the use of medical care services (MCS) and long-term care services (LTCS) before and after RTI-related hospitalization using LIFE Study data. In addition, we analyzed the data while adopting a difference-in-differences (DID) approach to address background changes in outcomes.

1. Fukuda H, Onizuka H, Murata F. Medical expenditures for community-acquired pneumococcal disease in Japan. J. *Natl. Inst. Public Health.* 2022;71(1):87-91.
2. Campling J, Jones D, Chalmers J, Jiang Q, Vyse A, Madhava H, et al. Clinical and financial burden of hospitalised community-acquired pneumonia in patients with selected underlying comorbidities in England. *BMJ Open Respir Res.* 2020;7(1).

Methods

This study was conducted as a pre-post assessment across RTI-related hospitalizations. Data between April 2018 and March 2023 were acquired from 12 Japanese municipalities. We identified RTI-related hospitalizations in residents aged ≥65 years between April 2019 and March 2022, and categorized them into the following two groups based on their diagnoses: pneumonia and aspiration pneumonia. We then compared each individual's use of MCS (e.g., outpatient MCS) and LTCS (e.g., in-home LTCS) between one year before and one year after the hospitalization event.

Next, we estimated the socioeconomic burden of RTI-related hospitalization using conditional logistic regression analysis with a DID approach (1:4 risk-set sampling between cases and controls matched for resident municipality, sex, and age) [3].

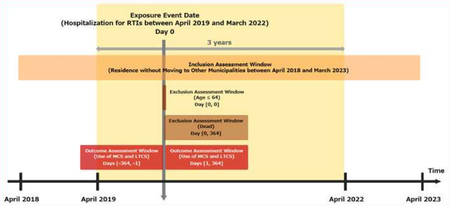

Fig 1. Study design
Abbreviations: LTCS, long-term care services; MCS, medical care services; RTI, respiratory tract infection.

3. Dimick JB, Ryan AM. Methods for evaluating changes in health care policy: the difference-in-differences approach. *JAMA.* 2014;312(22):2401-2.

Results & Discussion

From 267,757 participants, we identified 32,402 hospitalized cases of pneumonia and aspiration pneumonia between April 2019 and March 2022. The attributable risks of MCS and LTCS due to pneumonia-related hospitalization were as follows: outpatient MCS, -0.079 (95% CI: -0.084, -0.075); inpatient MCS, 0.101 (0.092-0.110); ambulatory LTCS, -0.025 (-0.033, -0.016); and facility-based LTCS, 0.055 (0.047-0.063). The DID odds ratios for pneumonia-related hospitalization that adjusted for underlying time-dependent trends were as follows: outpatient MCS, 0.21 (95% CI: 0.19-0.24); inpatient MCS, 1.50 (1.45-1.57); ambulatory LTCS, 0.77 (0.73-0.82); and facility-based LTCS, 1.18 (1.11-1.26). This study has several limitations. First, hospitalizations and outcomes were identified from claims data, which may include coding errors and diagnostic inaccuracies. Second, RTI severity, treatment method, and hospitalization duration were not included as potential confounders. Third, the study population was limited to National Health Insurance enrollees and Latter-Stage Older Persons Health Care System enrollees residing in 12 municipalities. As such, they may not be representative of the entire Japanese population.

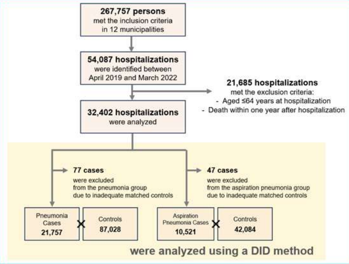

Fig 2. Study flow diagram
Abbreviation: DID, difference-in-differences.

	Pneumonia				Aspiration Pneumonia			
Number of cases	21,834				10,568			
Age (years), mean ± SD	82.3 ± 8.0				84.6 ± 7.7			
Female	10,835 (49.6)				5389 (51.0)			
	Before	After	AR (%)	*P*-value [1]	Before	After	AR (%)	*P*-value [1]
Outpatient MCS	21,259 (97.4)	19,529 (89.4)	-7.9	< 0.05	10,144 (96.0)	8295 (78.5)	-17.5	< 0.05
In-home MCS	2751 (12.6)	3566 (16.3)	3.7	< 0.05	2366 (22.4)	2587 (24.5)	2.1	< 0.05
Inpatient MCS	8382 (38.4)	10587 (48.5)	10.1	< 0.05	4519 (42.8)	5272 (49.9)	7.1	< 0.05
Ambulatory LTCS	6069 (27.8)	5530 (25.3)	-2.5	< 0.05	3739 (35.4)	2692 (25.5)	-9.9	< 0.05
In-home LTCS	4593 (21.0)	5100 (23.4)	2.3	< 0.05	2942 (27.8)	2684 (25.4)	-2.4	< 0.05
Facility-based LTCS	4908 (22.5)	6107 (28.0)	5.5	< 0.05	4506 (42.6)	5079 (48.1)	5.4	< 0.05

Values are presented as n (%) unless otherwise indicated.
1. McNemar's test with Yates' continuity correction was used to compare proportions of paired nominal data.
Abbreviations: AR, attributable risk; LTCS, long-term care services; MCS, medical care services; SD, standard deviation.

Table 1. Overview of baseline characteristics and outcomes

	Pneumonia					Aspiration Pneumonia				
	AR [1] (%)	RR [1]	OR [1]	DID OR [2] (95% CI)	*P*-value	AR [1] (%)	RR [1]	OR [1]	DID OR [2] (95% CI)	*P*-value
Outpatient MCS	-7.9	0.92	0.23	0.21 (0.19-0.24)	< 0.05	-17.4	0.82	0.15	0.13 (0.12-0.15)	< 0.05
In-home MCS	3.8	1.3	1.36	1.12 (1.04-1.20)	< 0.05	2.1	1.09	1.12	0.88 (0.81-0.96)	< 0.05
Inpatient MCS	10.1	1.26	1.51	1.50 (1.43-1.57)	< 0.05	7.2	1.17	1.33	1.31 (1.23-1.40)	< 0.05
Ambulatory LTCS	-2.4	0.91	0.88	0.77 (0.73-0.82)	< 0.05	-9.9	0.72	0.62	0.53 (0.49-0.57)	< 0.05
In-home LTCS	2.3	1.11	1.15	1.02 (0.96-1.08)	0.49	-2.4	0.91	0.88	0.75 (0.69-0.81)	< 0.05
Facility-based LTCS	5.5	1.25	1.34	1.18 (1.11-1.26)	< 0.05	5.5	1.13	1.25	1.03 (0.95-1.12)	0.45

1. Values in ARs, RRs, and ORs were calculated from cases in each RTI group.
2. The association between RTI-related hospitalization and the use of MCS and LTCS was estimated using a conditional logistic regression analysis for the interaction between pre-post and case-control variables.
Abbreviations: AR, attributable risk; CI, confidence interval; DID, difference-in-differences; LTCS, long-term care services; MCS, medical care services; OR, odds ratio; RR, risk ratio; RTI, respiratory tract infection.

Table 2. Association between RTI-related hospitalization and the use of MCS and LTCS

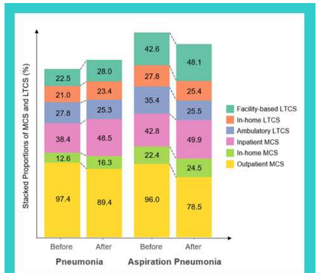

Fig 3. Changes in the use of MCS and LTCS through RTI-related hospitalization
Abbreviations: LTCS, long-term care services; MCS, medical care services; RTI, respiratory tract infection.

Conclusions

This study found that RTI-related hospitalization significantly decreased the use of outpatient MCS, but significantly increased the use of inpatient MCS and facility-based LTCS. These findings suggest that RTIs' socioeconomic burden could be reduced through appropriate preventive measures.

Declaration of Competing Interests
The study was supported by an investigator-initiated study grant from Pfizer Japan Inc.