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Ecological Analysis of Factors Associated with Mortality of Cerebral Infarction in Japan

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Abstract

Based on the aggregate indicators extracted from the National Database (NDB) that is constructed by the Ministry of Health, Labour and Welfare (MHLW) based on all the claim data of health insurance, we have investigated factors associated with mortality of cerebral infarction in Japan.

According to the result of multiple regression analysis, SCR of ICU care (regression coefficient = −0.012), number of neuro-surgeon per 100,000 inhabitants (coefficient = −0.356), number of physiotherapist per 100,000 inhabitants (−0.043) and average emergency transfer distance of cerebral infarction case (0.449) have been detected as factors with statistical significance.

The finding has indicated that the health care delivery condition might influence the mortality of cerebral infarction. If it is true, the health policy makers and health care providers must do effort in order to ameliorate this situation. It is an important challenge how to strengthen the effectiveness of Regional Health Care Plan.

Keywords: Regional Health Care Plan, Stroke, Mortality, Health care planning, Japan

❖Introduction

Cerebro-vascular diseases (CVDs) was the first cause of deaths before 1970 in Japan. The improvement of quality of daily life, especially that of dietary habit (i.e., less salty food), the medical innovation of pharmaceutical treatment of hypertension and the development of new drugs for cerebral stroke, have largely contributed to the rapid decrease of CVD mortality. However, As CVD still remains as the forth cause of deaths and the first cause of dependency, CVD occupies an important part of health policy in Japan.

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The Ministry of Health, Labour and Welfare (MHLW) requires for each prefectural government to establish its Regional Health Care Plan (RHCP) for every five years. It is one of the mandatory themes in RHCP how to organize the health care delivery system for CVD in order to meet the local needs. The RHCP describes the goal of each program, i.e., reduction of CVD mortality for 10% within the coming five years. This requires a set of information for monitoring. As mentioned by Matsuda and Fujimori in this volume, formerly we have a problem of shortage of information for evaluation of performance of health care system[1)]. However, the establishment of National Database has changed the situation completely. Using this big data we are now able to investigate the details of performance of the Japanese health care delivery system. It is a hot issue of debate now how to use this database for health policy. In order to contribute this discussion, we have tried to use the opened results of first attempt to apply NDB for planning of RHCP. In this article, we

will present a result of ecological study that has tried to evaluate the factors associated with mortality of cerebral infarction in Japan.

❖Material and method

We have used the opened results of first research attempt to apply the NDB for planning of RHCP by Matsuda[2]. This study used the claim data from October 2010 to March 2011. In this study the authors have proposed a new indicator, so called Standardized Claim Ratio (SCR). This is based on the same idea of calculation of Standardized Mortality Ration (SMR) as shown in Figure 1. If the ICU SCR is over 100, this means that the corresponded prefecture uses more ICU care compared with national average.

In order to investigate the factors associated with mortality of cerebral stroke, we have examined the relationship among the following variables;

1) SCR of DPC based hospital care, 2) SCR of Rehabilitation hospital care, 3) SCR of ICU care, 4) SCR of treatment by tPA, 5) SCR of acute phase rehabilitation care, 6) SCR for inter-hospital collaboration, 7) SMR of cerebral infarction (Male)[3], 8) SMR of cerebral infarction (Female)[3], 9) Number of neurologist per 100,000 inhabitants[4], 10) Number of neuro-surgeon per 100,000 inhabitants[5], 11) Number of physiotherapist per 100,000 inhabitants[6], 12) Number of occupational therapist per 100,000 inhabitants[6], 13) Number of speech therapist per 100,000 inhabitants[6], 14) average emergency transfer distance of cerebral infarction case[7]

Among the above mentioned variables, numbers of professional were obtained from the national association of each professional, and the mortality was from the National Statistics Bureau. The average emergency transfer distance of cerebral infarction case was obtained from the opened result of our previous study.

After examined the correlation among the above mentioned variables, we have conducted the multivariate analysis that uses the SMR of cerebral infarction (Female) as dependent variables and other variables except for SMR of cerebral infarction (Male) as independent variables.

❖Results

Table 1 shows the correlation matrix among the 14 variables. Variables that show statistically significant correlation with the SMR of cerebral infarction (Female) were SCR of DPC based hospital care (−0.428), SCR of Rehabilitation hospital care (−0.415), SCR of ICU care (−0.495), SCR of acute phase rehabilitation care (−0.419), SMR of cerebral infarction (Male) (0.792), Number of neuro-surgeon per 100,000 inhabitants (−0.358), Number of physiotherapist per 100,000 inhabitants (−0.414), Number of occupational therapist per 100,000 inhabitants (−0.322), Number of speech therapist per 100,000 inhabitants (−0.315), average emergency transfer distance of cerebral infarction case (0.402).

Table 2 shows the results of multiple regression analysis concerning factors associated with the SMR of cerebral infarction of female (Stepwise method). The statistically significant factors are SCR of ICU care (regression coefficient = −0.012), Number of neuro-surgeon per 100,000 inhabitants (−0.356), Number of physiotherapist per 100,000 inhabitants (−0.043) and average emergency transfer distance of cerebral infarction case (0.449). R^2=0.50

❖Discussion

There are several limitations for the current analysis. First, this study is an ecologic study based on the aggregated data. Therefore, we could not exclude the possible bias caused by ecologic fallacy. Second, as we used the first main diagnosis only, the morbidity of cerebral infarction might be underestimated. Third, we used the information of registered procedures only.

$$\text{Standardized Claim Ration (SCR)} = \frac{Observed\ number\ of\ claims}{Expected\ number\ of\ claims} \times 100$$

$$= \frac{\sum Observed\ number\ of\ claims\ of\ each\ age\ group\ i\ \times 100}{\sum Number\ of\ age\ group\ i\ of\ standard\ population \times Claim\ rate\ of\ age\ group\ i}$$

Standard population=Japanese total population of 2010

Figure 1 Formula of Standardized Claim Ratio

Table 1 Correlation matrix among the 14 studied variables

	SCR of DPC based hospital care	SCR of Rehabilitation hospital care	SCR of ICU care	SCR of treatment by tPA	SCR of acute phase rehabilitation care	SCR for inter-hospital collaboration	SMR of cerebral infarction (Male)	SMR of cerebral infarction (Female)	Number of neurologist per 100,000 inhabitants	Number of neuro-surgeon per 100,000 inhabitants	Number of physiotherapist per 100,000 inhabitants	Number of occupational therapist per 100,000 inhabitants	Number of speech therapist per 100,000 inhabitants	average emergency transfer distance of cerebral infarction case
SCR of DPC based hospital care	1	.176	.400**	−.062	.406**	.269	−.430**	−.428**	.321*	.286	.119	.170	.119	−.246
		.237	.005	.677	.005	.068	.003	.003	.028	.052	.424	.254	.424	.096
SCR of Rehabilitation hospital care	.176	1	.398**	.323*	.748**	.528**	−.217	−.415**	.125	.307*	.808**	.802**	.767**	−.007
	.237		.006	.027	.000	.000	.143	.004	.402	.036	.000	.000	.000	.965
SCR of ICU care	.400**	.398**	1	.193	.600**	.278	−.505**	−.495**	−.014	.143	.347*	.328*	.326*	−.250
	.005	.006		.193	.000	.058	.000	.000	.927	.339	.017	.025	.025	.090
SCR of treatment by tPA	−.062	.323*	.193	1	.322*	.031	−.084	−.174	.097	.361*	.397**	.333*	.316*	.055
	.677	.027	.193		.027	.838	.574	.243	.519	.013	.006	.022	.031	.712
SCR of acute phase rehabilitation care	.406**	.748**	.600**	.322*	1	.559**	−.283	−.419**	.192	.409**	.812**	.778**	.814**	.067
	.005	.000	.000	.027		.000	.054	.003	.196	.004	.000	.000	.000	.654
SCR for inter-hospital collaboration	.269	.528**	.278	.031	.559**	1	−.157	−.237	.076	.197	.549**	.569**	.556**	.184
	.068	.000	.058	.838	.000		.293	.109	.613	.183	.000	.000	.000	.215
SMR of cerebral infarction (Male)	−.430**	−.217	−.505**	−.084	−.283	−.157	1	.792**	−.077	−.048	−.195	−.082	−.140	.424**
	.003	.143	.000	.574	.054	.293		.000	.605	.751	.188	.583	.348	.003
SMR of cerebral infarction (Female)	−.428**	−.415**	−.495**	−.174	−.419**	−.237	.792**	1	.001	−.358*	−.414**	−.322*	−.315*	.402**
	.003	.004	.000	.243	.003	.109	.000		.997	.013	.004	.028	.031	.005
Number of neurologist per 100,000 inhabitants	.321*	.125	−.014	.097	.192	.076	−.077	.001	1	.172	.133	.167	.190	.025
	.028	.402	.927	.519	.196	.613	.605	.997		.246	.373	.261	.202	.866
Number of neuro-surgeon per 100,000 inhabitants	.286	.307*	.143	.361*	.409**	.197	−.048	−.358*	.172	1	.571**	.464**	.498**	.103
	.052	.036	.339	.013	.004	.183	.751	.013	.246		.000	.001	.000	.492
Number of physiotherapist per 100,000 inhabitants	.119	.808**	.347*	.397**	.812**	.549**	−.195	−.414**	.133	.571**	1	.905**	.930**	.257
	.424	.000	.017	.006	.000	.000	.188	.004	.373	.000		.000	.000	.082
Number of occupational therapist per 100,000 inhabitants	.170	.802**	.328*	.333*	.778**	.569**	−.082	−.322*	.167	.464**	.905**	1	.900**	.266
	.254	.000	.025	.022	.000	.000	.583	.028	.261	.001	.000		.000	.071
Number of speech therapist per 100,000 inhabitants	.119	.767**	.326*	.316*	.814**	.556**	−.140	−.315*	.190	.498**	.930**	.900**	1	.338*
	.424	.000	.025	.031	.000	.000	.348	.031	.202	.000	.000	.000		.020
average emergency transfer distance of cerebral infarction case	−.246	−.007	−.250	.055	.067	.184	.424**	.402**	.025	.103	.257	.266	.338*	1
	.096	.965	.090	.712	.654	.215	.003	.005	.866	.492	.082	.071	.020	
Descriptive statistics														
Mean	100.30	106.87	90.50	103.46	103.69	111.66	25.99	12.89	3.83	5.61	43.22	29.02	8.89	9.51
SD	19.59	41.13	43.37	31.27	22.28	66.92	4.11	2.19	1.62	1.06	17.65	10.99	3.67	2.20
Min	60.09	53.57	27.19	49.99	65.23	0.00	17.70	9.10	1.90	3.67	23.26	14.33	4.37	5.20
Max	154.51	212.05	223.73	198.84	168.03	281.61	35.80	17.40	9.06	8.18	113.56	57.02	22.36	14.60
Max/Min	2.57	3.96	8.23	3.98	2.58	#DIV/0!	2.02	1.91	4.77	2.23	4.88	3.98	5.12	2.81

*: statistically significamnt at 5% level, **: statistically significamnt at 1% level

Table 2 Result of multiple regression models on factors associated with mortality of cerebral infarction (47 prefectures)

	Coeffcient	SE	Standardized coefficient	t value	p value
Copnstant	11.943	1.325		9.014	.000
SCR of ICU care	−.011	.006	−.221	−1.756	.086
average emergency transfer distance	.463	.122	.464	3.797	.000
Number of physiotherapist per 100,000 inhabitants	−.057	.016	−.456	−3.618	.001

That is, procedures that were not registered for reimbursement were systematically excluded from the database. This might cause bias for evaluation of ICU related indicators. As hospitals must have the structure required by law in order to receive the reimbursement for "ICU" care, the facilities without enough structure cannot receive the reimbursement for ICU equivalent care. This might be problems for rural hospitals that face the difficulty to have enough number of medical staffs. Regarding the above mentioned limitations, we would like to discuss the current results.

The finding that the health care delivery condition might influence the mortality of cerebral infarction should be severely accepted by the health policy makers and health care providers. As Table 1 and 2 indicated, more the critical phase of care (i.e., ICU care) and more specialists for cerebral infarction treatment (i.e., neuro-surgeon and therapists), less SMR of cerebral infarction. It is important to recognize that this study is an ecologic one. So we have to clarify this hypothesis by using a micro data.

Because of "freedom of medical doctors for career choice and working place", we have a problem of unbalanced distribution of medical resources. If the current observation can be generalized, we have to ameliorate the situation. As the solidarity is a basic philosophy of our universal health assurance scheme, it requires an equal access for the citizen. In fact, the RHCP is a guideline for solving this problem. Unfortunately, it has not been functioning for this purpose up to now. In order to improve the effectiveness of RHCP, MHLW has strengthened the PDCA approach in the 6th RHCP. To support this planning process, MHLW and our research team have prepared a series of planning tools, i.e., forecasting program of disease structures, visualizing tool of disease structures of each HCR[8]. We have organized seminars for persons in charge of planning in each prefecture. One example of these tools is presented by Matsuda et al in this volume[9]. These tools are expected to ameliorate the quality and practicability of RHCP.

❖Literatures

1) Shinya Matsuda S and Kenji Fujimori: The claim database in Japan, APJDM, Vol.6(3·4):, 2012:33-37
2) Shinya Matsuda: Study on the development of basic dataset for Regional Health Care Plan-an application of DPC and NDB-, In: Report on Evaluation of collaboration among the health facilities based on Regional Health Care Plan (Chief researcher: K Kawahara), 2012. (in Japanese)
3) National Statistics Bureau: e-Stat, Causes of death 2010. https://www.e-stat.go.jp/ (Jan10, 2012 access)
4) Japan Association of Neurology: http://www.kktcs.co.jp/jsn-senmon/secure/senmon.aspx, (Jan10, 2012 access)
5) Japanese College of Neurosurgery: https://www.jnss.or.jp/jns_web/jsp_pub/map.jsp, (Jan10, 2012 access)
6) MHLW: Hospital survey 2010. https://www.e-stat.go.jp/ (Jan10, 2012 access)
7) Shinya Matsuda: Analysis of average transfer distance of acute cerebral infarction cases in Japan, In: Report on Study of the development of evaluation method of cut-patient and in-patient care Chief researcher:(Fushimi K), 2012. (in Japanese)
8) Shinya Matsuda. Report on the Evaluation of collaboration among the different medical facilities based on the Regional Health Care Plan, 2013. (in Japanese)
9) Shinya Matsuda and Kenji Fujimori: Analysis of disease structure for the Regional Health Care Plan based on the National database, APJDM, Vol.6 (3,4):, 2012:45-50