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Study on Influence of Diabetes Mellitus for the Charged Cost and Length of Stay among the Angina Pectoris Patient in Japan

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Abstract

In order to clarify the importance of diabetes control, the authors examine the impact of diabetes mellitus on resource consumption among the angina pectoris patient institutionalized in the Japanese acute hospitals. We used the 2009 DPC database. The DPC database is a discharge summary and administrative claims database that represents approximately 50% inpatient admissions to acute care hospitals in Japan. Among 2,553,283 acute in-patient cases of 855 hospitals, we extracted 115,868 patients with the diagnosis of angina pectoris (DPC code with six digits=050050). Based on this dataset, we compared the resource consumption measured by length of stay and charged cost between the angina pectoris patients with diabetes and those without diabetes. The diabetic patients showed lower mean ages (male: 68.1 vs. 67.2, female: 73.0 vs. 71.4), longer length of stay (male: 6.4 vs. 6.9, female: 7.6 vs. 8.3), higher charged cost (male: 140,314.0 vs.145,206.9, female: 143,305.1 vs. 149,252.1; 1 point = 10 JPY) and higher CCI (male: 1.3 vs. 1.6, female: 1.3 vs.1.5) with statistical significances. Furthermore, there was a wide regional variation among the diabetes prevalence among the observed population. The present analysis has clarified that diabetes increase the resource consumption among the angina pectoris patients. In order to control the health expenditures and ameliorate the population's health status, the preventive activity of diabetes must be put more emphasis.

Key words: diabetes mellitus, angina pectoris, DPC, resource consumption

❖Introduction

Along with the socio-economic development, the Japanese disease structure has changed from the acute diseases dominant to the life-style related chronic diseases dominant pattern. The life style related diseases account for two-thirds of total deaths, and one third of

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health expenditures in Japan[1, 2]. As other developed countries, the incidence of ischemic heart diseases (IHD) has been increasing. According to the Patient survey in 2008, there were 406 thousands IHD patients who received medical treatments during the survey periods (3 days at the end of October) in Japan[3]. Because of the advanvce in medical technology, most of the ischemic heart diseases patients can survive after the acute event that was formaerly fatal. However, the advance in survival rate causes the increase of chronic heart failure patients. Thus it becomes very impoprtant to prevent the ischemic heart diseases patients in order to ameliorate the population's health and at the same to control the health expenditures.

Behind the rapid increase of IHD, there is a problem of the increase of diabetes patients. According to the result of 2008 National Diebetes Suvey, it is estimated that 18.7 million persons had diabetes mellitus or its possibility[4]. Today diabetes becomes one of the biggest threats for public health in Japan.

In order to clarify the importance of diabetes control, the authors have examined the impact of diabetes mellitus on resource consumption among the angina pectoris patients who were institutionalized in the Japanese acute hospitals based on the Diagnosis Procedure Combinations (DPC) data of 2008.

❖Methods

The DPC database

The DPC database is a discharge summary and administrative claims database that represents approximately 50% inpatient admissions to acute care hospitals in Japan [5]. Data are compiled between 1 July and 31 December 2008 by the DPC Research Group funded by the Ministry of Health, Labour and Welfare, Japan. The total number of cases was 2,553,283 from 855 hospitals. For this study, we extracted 115,868 patients with the diagnosis of angina pectoris (DPC code with six digits=050050).

The database includes the following data: location of hospitals; date of admission and discharge; patients' age and sex; diagnoses, comorbidities and complications; drugs and devices used; procedures; lengths of stay and charged base cost (Fee for Service equivalent). In the DPC database, the diagnoses were recorded with the International Classification of Diseases, Tenth Revision (ICD-10) codes and text data in Japanese language.

Under the DPC scheme, the payment for hospitals composes of two components; DPC component and Fee-For-Service component. The DPC component corresponds to the "so called" hospital fee, which contains hotel fee, pharmaceuticals and supplies used in wards, lab-test, radiological examination, and procedures cheaper than ¥10,000 (US$ 100; 1USD=100 JPY). The FFS component corresponds to tariffs for surgical procedures and anesthesia, pharmaceuticals and expensive devices used in operation rooms, and procedures more than ¥10,000 (US$ 100). For the DPC component, per diem payment schedule is set for each DPC group. In this analysis, we did not use the bundled prices for the calculation of cost. We estimated a fee-for-service charged cost based on the detailed process data that was collected in the DPC research program.

Analyses

At first, we performed the descriptive analyses of studied population about sex, age, DPC coding, prevalence of diabetes mellitus, regional distribution. Then we compared the resource consumption measured by length of stay and charged cost between the angina pectoris patients with diabetes and those without diabetes. In order to make the comparison homogenous, the patients with DPC "050050xx03x0xx (Angina pectoris, percutaneous coronary intervention, no additional intervention)" were used for the comparison because the number of patient with this classification was large enough for the further analyses. The threshold for significance was a p value of less than 0.05. All the statistical analyses were conducted with the use of the software Statistical Package for Social Sciences (SPSS) version 15.0J (SPSS Inc., Tokyo, Japan).

Study approval was obtained from our institutional review board (University of Occupational and Environmental Health).

❖Results

Table 1 shows basic statistics of studied population. There were 115,868 angina pectoris cases during 1 July to 31 December 2008. Seventy one percent (82,624) were male patients and 24.4% (28,262) had diabetes as co-morbidity. So far as DPC classifications, "050050xx9910xx (Angina pectoris, no surgi-

Table 1 Basic statistics of studied population

Sex	N	%
Male	82,624	71.3
Female	33,244	28.7
DPC	**N**	**%**
050050xx01x0xx	23	0.0
050050xx01x2xx	6	0.0
050050xx01x4xx	7	0.0
050050xx02x0xx	2,908	2.5
050050xx02x1xx	255	0.2
050050xx02x2xx	586	0.5
050050xx02x3xx	1	0.0
050050xx02x4xx	687	0.6
050050xx03x0xx	31,955	27.6
050050xx03x10x	1,363	1.2
050050xx03x11x	646	0.6
050050xx03x2xx	2,688	2.3
050050xx03x3xx	14	0.0
050050xx03x4xx	652	0.6
050050xx97x0xx	534	0.5
050050xx97x1xx	41	0.0
050050xx97x2xx	203	0.2
050050xx97x3xx	2	0.0
050050xx97x4xx	363	0.3
050050xx99000x	3,147	2.7
050050xx99001x	1,120	1.0
050050xx9901xx	122	0.1
050050xx9902xx	1,392	1.2
050050xx9903xx	1	0.0
050050xx9910xx	59,516	51.4
050050xx9911xx	2,247	1.9
050050xx9912xx	5,383	4.6
050050xx9913xx	6	0.0
Diabetes	**N**	**%**
No	87,606	75.6
Yes	28,262	24.4
Total	115,868	100.0

9th and 10th digits for surgery
01: Disection of cardiac aneurysm, 02: CABG, 03: PCI, 97: Other surgical procedures, 99: No surgery.

12th digit for additional procedure
0: No additional prpcedure, 1: Haemodyalysis, SPECT, t-PA, Pacemaking.

13th digit for comorbidities and complications (CC)
0: No CC, 1: Existed CC.

cal intervention, with cathetel examination)" was the most frequent (59,516 cases; 51.4%), followed by "050050xx03x0xx (Angina pectoris, percutaneous coronary intervention, no additional intervention)"; 31,955 cases (27.6%). Average of age, length of stay and total charged cost were 68.5 yr old (SD: 10.4), 6.7 days (SD: 9.4) and 78607.9 points (SD: 100364.5, 1point =10 Japanese yen), respectively.

Table 2 shows the prevalence rate of diabetes stratified by sex and prefecture. There were wide regional variations in prevalence. The highest prevalence was observed in Tokushima prefecture for male (43.2%) and in Mie prefecture for female (38.8%). The lowest prevalence was observed in Okayama (11.4%) for male and in Ehime prefecture for female (8.7%).

Table 3 shows the outcome at discharge stratified by the existence of diabetes. There was no difference in outcome; 97% of angina pectoris cases of DPC "050050xx03x0xx" recovered.

Table 4 shows the results of comparison of resource consumption between diabetic cases and non-diabetic ones (DPC "050050xx03x0xx"). The diabetic patients showed lower mean ages (male: 68.1 vs. 67.2, female: 73.0 vs. 71.4), longer length of stay (male: 6.4 vs. 6.9, female: 7.6 vs. 8.3), higher charged cost (male: 140,314.0 vs.145,206.9, female: 143,305.1 vs. 149,252.1; 1 point = 10 JPY) and higher Charlson's Co-morbidity Index (male: 1.3 vs. 1.6, female: 1.3 vs.1.5) with statistical significances. For charged cost, consultation (561.8 vs. 675.6), prescription (1,348.2 vs. 1,588.2), injection (759.9 vs. 855.7) and surgical intervention (118,770.3 vs. 121,949.9) were higher for male with statistical significance and consultation (627.1 vs. 789.4), prescription (1,463.6 vs. 1,691.1), and surgical intervention (117,776.7 vs. 121,965.9) were higher for female with statistical significance.

❖Discussion

It is well known that diabetes is one of the most important risk factors for ischemic heart diseases. For example, Almdal *et al.* reported that the diabetic patients showed 1.5- to 4.5-fold (women) and 1.5- to 2-fold (men) more possibility to experience the ischemic heart diseases (IHDs) and 1.5 to 2 times more possibility of death[6]. According to the results of present study, the diabetic patients would have IHDs at

Table 2 Prevalence of diabetes stratified by sex and prefecture (DPC code with six digits =050050)

		Male		Female		Both sex	
		Diabetes	Sub-Total	Diabetes	Sub-Total	Diabetes	Sub-Total
01 Hokkaido	N	1,154	4,799	492	2,098	1,646	6,897
	%	24.0	100.0	23.5	100.0	23.9	100.0
02 Aomori	N	55	431	31	178	86	609
	%	12.8	100.0	17.4	100.0	14.1	100.0
03 Iwate	N	312	1,027	106	365	418	1,392
	%	30.4	100.0	29.0	100.0	30.0	100.0
04 Miyagi	N	387	1,564	155	697	542	2,261
	%	24.7	100.0	22.2	100.0	24.0	100.0
05 Akita	N	120	560	40	208	160	768
	%	21.4	100.0	19.2	100.0	20.8	100.0
06 Yamagata	N	108	821	44	303	152	1,124
	%	13.2	100.0	14.5	100.0	13.5	100.0
07 Fukushima	N	215	759	85	342	300	1,101
	%	28.3	100.0	24.9	100.0	27.2	100.0
08 Ibaraki	N	452	2,064	118	633	570	2,697
	%	21.9	100.0	18.6	100.0	21.1	100.0
09 Tochigi	N	291	910	78	280	369	1,190
	%	32.0	100.0	27.9	100.0	31.0	100.0
10 Gunma	N	371	1,445	142	627	513	2,072
	%	25.7	100.0	22.6	100.0	24.8	100.0
11 Saitama	N	811	2,289	289	825	1,100	3,114
	%	35.4	100.0	35.0	100.0	35.3	100.0
12 Chiba	N	849	3,196	346	1,227	1,195	4,423
	%	26.6	100.0	28.2	100.0	27.0	100.0
13 Tokyo	N	1,722	6,815	525	2,218	2,247	9,033
	%	25.3	100.0	23.7	100.0	24.9	100.0
14 Kanagawa	N	1,652	6,801	605	2,788	2,257	9,589
	%	24.3	100.0	21.7	100.0	23.5	100.0
15 Niigata	N	135	504	53	201	188	705
	%	26.8	100.0	26.4	100.0	26.7	100.0
16 Toyama	N	153	673	69	312	222	985
	%	22.7	100.0	22.1	100.0	22.5	100.0
17 Ishikawa	N	341	1,393	120	642	461	2,035
	%	24.5	100.0	18.7	100.0	22.7	100.0
18 Fukui	N	51	184	35	106	86	290
	%	27.7	100.0	33.0	100.0	29.7	100.0
19 Yamanashi	N	10	38	4	24	14	62
	%	26.3	100.0	16.7	100.0	22.6	100.0
20 Nagano	N	250	964	95	418	345	1,382
	%	25.9	100.0	22.7	100.0	25.0	100.0
21 Gifu	N	441	2,633	163	1,083	604	3,716
	%	16.7	100.0	15.1	100.0	16.3	100.0
22 Shizuoka	N	306	1,990	116	751	422	2,741
	%	15.4	100.0	15.4	100.0	15.4	100.0
23 Aichi	N	676	3,748	259	1,370	935	5,118
	%	18.0	100.0	18.9	100.0	18.3	100.0
24 Mie	N	388	1,104	153	394	541	1,498
	%	35.1	100.0	38.8	100.0	36.1	100.0

Table 2 Prevalence of diabetes stratified by sex and prefecture (DPC code with six digits =050050)

		Male		Female		Both sex	
		Diabetes	Sub-Total	Diabetes	Sub-Total	Diabetes	Sub-Total
25	N	281	1,309	121	575	402	1,884
Shiga	%	21.5	100.0	21.0	100.0	21.3	100.0
26	N	263	1,534	109	613	372	2,147
Kyoto	%	17.1	100.0	17.8	100.0	17.3	100.0
27	N	2,262	7,915	803	2,931	3,065	10,846
Osaka	%	28.6	100.0	27.4	100.0	28.3	100.0
28	N	719	3,477	274	1,229	993	4,706
Hyogo	%	20.7	100.0	22.3	100.0	21.1	100.0
29	N	138	762	58	319	196	1,081
Nara	%	18.1	100.0	18.2	100.0	18.1	100.0
30	N	141	457	63	216	204	673
Wakayama	%	30.9	100.0	29.2	100.0	30.3	100.0
31	N	154	703	56	240	210	943
Tottori	%	21.9	100.0	23.3	100.0	22.3	100.0
32	N	77	387	27	189	104	576
Shimane	%	19.9	100.0	14.3	100.0	18.1	100.0
33	N	171	1,501	83	577	254	2,078
Okayama	%	11.4	100.0	14.4	100.0	12.2	100.0
34	N	419	1,392	185	678	604	2,070
Hiroshima	%	30.1	100.0	27.3	100.0	29.2	100.0
35	N	212	894	108	427	320	1,321
Yamaguchi	%	23.7	100.0	25.3	100.0	24.2	100.0
36	N	543	1,257	102	487	645	1,744
Tokushima	%	43.2	100.0	20.9	100.0	37.0	100.0
37	N	130	536	52	208	182	744
Kagawa	%	24.3	100.0	25.0	100.0	24.5	100.0
38	N	44	225	9	103	53	328
Ehime	%	19.6	100.0	8.7	100.0	16.2	100.0
39	N	45	185	18	82	63	267
Kochi	%	24.3	100.0	22.0	100.0	23.6	100.0
40	N	1,430	5,857	624	2,755	2,054	8,612
Fukuoka	%	24.4	100.0	22.6	100.0	23.9	100.0
41	N	94	313	40	158	134	471
Saga	%	30.0	100.0	25.3	100.0	28.5	100.0
42	N	333	1,415	153	678	486	2,093
Nagasaki	%	23.5	100.0	22.6	100.0	23.2	100.0
43	N	576	1,594	262	731	838	2,325
Kumamoto	%	36.1	100.0	35.8	100.0	36.0	100.0
44	N	238	819	105	425	343	1,244
Oita	%	29.1	100.0	24.7	100.0	27.6	100.0
45	N	247	964	76	371	323	1,335
Miyazaki	%	25.6	100.0	20.5	100.0	24.2	100.0
46	N	370	1,150	143	515	513	1,665
Kagoshima	%	32.2	100.0	27.8	100.0	30.8	100.0
47	N	346	1,266	185	647	531	1,913
Okinawa	%	27.3	100.0	28.6	100.0	27.8	100.0
	N	20,483	82,624	7,779	33,244	28,262	115,868
All Japan	%	24.8	100.0	23.4	100.0	24.4	100.0

Table 3 Outcome at discharge stratified by existence of diabetes
(DPC "050050xx03x0xx")

Outocome	Non-diabetic	Diabetic	Total
Recovered	22,520 97.0%	8,473 96.9%	30,993 97.0%
No change	441 1.9%	173 2.0%	614 1.9%
Worsened	2 0.0%	2 0.0%	4 0.0%
Death due to Angina	18 0.1%	1 0.0%	19 0.1%
Death due to other cause	15 0.1%	2 0.0%	17 0.1%
Others	219 0.9%	89 1.0%	308 1.0%
Total	23,215 100.0%	8,740 100.0%	31,955 100.0%

χ^2 test: p=0.259.

younger age than non-diabetic cases and consume more resources (50,000 JPY more both for male and female), although there was no significant difference in outcome at discharge. The largest difference in resource consumptions was observed for surgical intervention. Yosefy reported that diabetic patients tended to experience the intervention related complications, such as bleeding, surgical site infection, re-surgery, etc[7]. Artheriosclerosis and immunological dysfunctions are considered as base factors.

It is very interesting that there is a wide geographical variation among the diabetes prevalence among the observed population. The National Diabetes Survey also indicated that a higher diabetes prevalence was observed for Tokushima prefecture[3]. Considering the relatively homogenous genetic characteristics of the Japanese, the differences in life style, especially diet related life style would explain this difference. Further epidemiological studies must be organized in order to clarify the mechanism of regional differences in prevalence.

In order to control the diabetic problems, the Ministry of Health, Labour and Welfare (MHLW) has introduced a new health promotion program called "Health checkups and healthcare advice with a particular focus on the metabolic syndrome" for the insured over 40 yr old. There is no doubt that diabetes has become one of the most important health threats for the Japanese. As we have suggested, this program will be useful if the proper strategy is employed[8, 9]. According to the results of our field study in Fukuoka prefecture, more than 40% of male inhabitants were obese and the prevalence of diabetes mellitus started to increase from 40 yr old [10]. This finding would support the validity of MHLW's strategy to start the preventive activity from 40 yr old. However, the same study has clarified that the middle aged men did not participate at the health check-up and following health education because of the inconvenient time and places setting. Considering the importance of new disease management program targeting the diabetes mellitus, both of MHLW and individual insurer must re-organize the content of program.

Several limitations should be acknowledged. The DPC survey is conducted only between 1 July and 31 December every year, and data between 1 January and 30 June were not available. Another limitation is that our study does not cover all DPC hospitals. Therefore the number of cases was heterogeneous among the regions, i.e., a relatively small rate for Ehime prefecture was observed. Furthermore, there is a possibility of low report rate for diabetes as co-morbidity, because the existence of diabetes is not used for further DPC classification of angina pectoris. However,

Table 4 Comparison of resource consumption between diabetic cases and non-doiabetic ones (DPC "050050xx03x0xx"; cost is described by "point". 1 point = 10 JPY)

		Male			
	Diabetes	N	Mean	SD	p value
Age	No	17,674	68.1	10.0	<0.001
	Yes	6,608	67.2	9.5	
Charged cost_Total	No	17,674	140,314.0	64,390.0	<0.001
	Yes	6,608	145,206.9	67,672.9	
Charged cost_Consultation	No	17,674	561.8	610.4	<0.001
	Yes	6,608	675.6	781.9	
Charged cost_Prescription	No	17,674	1,348.2	1,437.2	<0.001
	Yes	6,608	1,588.2	1,615.7	
Charged cost_Injection	No	17,674	759.9	2,980.1	0.025
	Yes	6,608	855.7	2,948.4	
Charged cost_Intervention	No	17,674	144.7	1,415.9	0.522
	Yes	6,608	132.6	994.2	
Charged cost_Surgical intevention	No	17,674	118,770.3	56,325.3	<0.001
	Yes	6,608	121,949.9	58,952.2	
Charged cost_labo-test	No	17,674	4,155.2	5,334.1	0.793
	Yes	6,608	4,175.2	5,150.1	
Charged cost_Diagnostic imaging	No	17,674	516.1	1,192.5	0.265
	Yes	6,608	535.3	1,198.8	
Chalson's Comorbity Index	No	5,683	1.3	0.6	<0.001
	Yes	6,179	1.6	0.8	
Length of stay	No	17,674	6.4	6.1	<0.001
	Yes	6,608	6.9	6.4	

		Female			
	Diabetes	N	Mean	SD	p value
Age	No	5,541	73.0	8.7	<0.001
	Yes	2,132	71.4	8.5	
Charged cost_Total	No	5,541	143,305.1	67,635.0	<0.001
	Yes	2,132	149,252.1	69,694.4	
Charged cost_Consultation	No	5,541	627.1	553.9	<0.001
	Yes	2,132	789.4	858.8	
Charged cost_Prescription	No	5,541	1,463.6	1,581.1	<0.001
	Yes	2,132	1,691.1	1,715.3	
Charged cost_Injection	No	5,541	950.6	3,447.2	0.535
	Yes	2,132	1,047.0	3,136.3	
Charged cost_Intervention	No	5,541	217.3	1,429.5	0.797
	Yes	2,132	227.1	1,639.2	
Charged cost_Surgical intevention	No	5,541	117,776.7	56,326.7	0.004
	Yes	2,132	121,965.9	57,557.0	
Charged cost_labo-test	No	5,541	4,734.8	5,687.3	0.499
	Yes	2,132	4,637.8	5,460.2	
Charged cost_Diagnostic imaging	No	5,541	665.1	1,396.6	0.413
	Yes	2,132	636.4	1,318.1	
Chalson's Comorbity Index	No	1,640	1.3	0.5	<0.001
	Yes	1,958	1.5	0.8	
Length of stay	No	5,541	7.6	8.1	0.002
	Yes	2,132	8.3	7.8	

p value: *t*-test, the normality of distributuion was checked by Levene's test. The modified *t*-test was employed for no-normal distribution cases.

as the low report rate of diabetes would have the effect in direction to reduce the differences in resource consumptions, there would be more large differences in resource consumptions between the diabetic and non-diabetic cases. It is very important to recognize that the DPC database, one of the administrative data, is an important information sources for health policy making. It is expected that this precious data will be further used by various organizations in order to promote the nation's health.

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