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Original Article

The relationship of hospital stay and readmission with employment status

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Abstract: The Inpatient Clinico-Occupational Survey collected data from 3.76 million patients, showing that the average length of stay declined by 16.1 d in FY2008 and by 14.1 d in FY2015. In this study, we assessed the length of hospital stay and readmission, stratified by ICD-10 and employment status. A cross-sectional study was conducted on data from FY2008, including those from 65,806 first hospitalizations and 16,653 readmissions in FY2008, where 62,260 first admissions and 29,242 readmissions in FY 2015. The length of hospital stay was longest in those admitted due to external influences (24.8 d), followed by musculoskeletal disorders (22.5 d). This remained unchanged in FY2015, however, lengths of stay of those were reduced by 20.1 and 20.0 d, respectively. The length of hospital stay for most diseases was longer upon readmission than on first admission, and longer for those who were unemployed. It is necessary to give attention to patients who need to be discharged early due to work, or plan for frequent hospitalization in order to reduce the length of each hospital stay because of the expected increase in the number of elderly workers brought on by a declining birth rate and an aging population.

Key words: Occupational health, Length of hospital stay, Promotion of health and employment support, Return to work, Workers

Introduction

Shorter hospital stays were reported to reduce medical costs and increase the bed turnover rate, which in turn lowers overall social costs[1, 2]. Length of hospital stay, therefore, is recognized as an important indicator of medical services, aside from the efficiency of hospital management, patient quality of care, and functional evaluation[3]. However, failing to consider readmission may sometimes result in wrong conclusions because the statistics regarding length of hospital stay could not be distinguished for multiple hospitalizations related to the same diseases. A flat-rate payment system for inpatient medical expenses using the diagnosis procedure combination (DPC) was introduced in Japan in 2003. After a full-scale introduction of the DPC, comprehensive evaluation began in 2006[4], and the average length of hospital stay has since short-

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ened. The average hospital stays for all ages in FY2008 versus in FY2015 were reduced by 16.3 d and 14.1 d, respectively, based on the Inpatient Clinico-Occupational Survey[5]. This is consistent with the results from a national hospital report by the Japanese Ministry of Health, Labour and Welfare where they found that the average length of hospital stays in Japan in 2018 was 16.1 d for patients in general beds[6]. Despite the length of hospital stays having declined to almost half its length 30 yr ago, Japan still has the longest lengths of hospital stay among OECD member countries[7].

Among the labour force in 2016, there were 4.5 million workers aged 65–69 yr old, while there were 3.36 million workers aged 70 yr or older. After the Act on Stabilization of Employment of Elderly Persons was enforced in 2013 that allowed for the continuous employment of applicants until 65 yr of age[8], the ratio of the total elderly population among the labour force participation rate continued to rise to 11.8%[9]. Consequently, promoting health and employment support became more necessary due to the higher frequency of various illnesses.

Therefore, in this study, we analysed the length of stay and the number of admissions based on the patients' major classification according to the tenth revision of the International Classification of Diseases (ICD-10), which is neither provided in hospital reports in Japan nor in the OECD World Health Data. The purpose of this study is to clarify the characteristics of patients which present problems for promoting health and employment support, such as having diseases that often require readmission after discharge, even if the length of stay is shortened.

Methods

Data sources

The Rosai Hospital Group, administrated by the Japan Organization of Occupational Health and Safety, has conducted an inpatient clinic survey annually since 1984. It is a large-scale survey wherein investigators at each Rosai hospital conducted interviews with inpatients regarding clinical and occupational health and investigates the inpatients' medical history, occupational history, and lifestyle habits, including smoking and alcohol history [10]. Approximately 250,000 inpatients from 33 hospitals nationwide, as of March 2020, are included in the survey. This is the first large-scale database in Japan that combines information on patients' clinical history with information on their occupational history. While some reports have been published on the relationship between occupational history and diseases such as cardiovascular disease and cancer[11, 12], no studies have examined the relationship between occupational health status and length of hospital stay. We used data from the Inpatient Clinico-Occupational Survey which surveyed all inpatients admitted to Rosai hospitals nationwide, excluding patients younger than 15 yr of age and patients admitted for a thorough medical check-up. Health information managers and occupational history surveyors at Rosai hospitals conducted interviews with inpatients and their families using a structured questionnaire. Currently, approximately 3.76 million data items have been accumulated from 1984 to 2018. The clinical history survey utilized the physicians' summary of inpatient treatments. The occupational history survey included patients hospitalized in the Rosai Hospital Group who were aged 15 yr and over, including self-employed patients and patients with no occupational history. Occupational investigators in each Rosai hospital performed structured interviews regarding participants' current occupations, their three most recent occupations, information on their clinical history, occupational history, and history of special medical examinations performed in accordance with the Industrial Safety and Health Law. The survey included questions about smoking and drinking habits, lifestyle-related diseases, height and weight, and willingness to return to work after discharge. Occupational histories were coded according to the Japan Standard Industrial Classification[13], and the Japanese Standard Occupation Classification[14].

The clinical history survey was coded based on the discharge summary, which provides basic information about the inpatient, and the definitive diagnosis using the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10)[15]. In contrast, surgical, diagnostic, and therapeutic procedures were coded using the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM)[16]. The information included in the self-administered questionnaire which was completed by the patient or their family was registered in the medical history database by the medical information manager and the occupational history investigator at each Rosai hospital, and approximately 7.17 million items of data were collected from 1984 to 2019. Data registered at the National Rosai Hospitals were collated at the organization's headquarters.

Population of the study

We compared the medical history survey and occupational history survey data between two fiscal years:

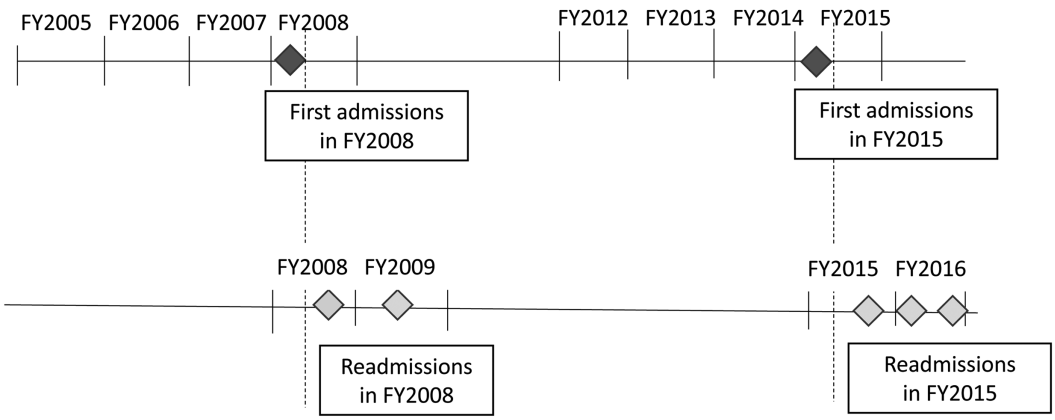

Fig. 1. Definitions of first and readmissions.

FY2008 and FY2015. Data were obtained from the Inpatient Clinico-Occupational Survey database but the study excluded those from patients who were hospitalized in special hospitals for psychiatric and rehabilitation purposes. Moreover, from among the many patients admitted to Rosai hospitals, the study targeted discharged patients aged between 15 and 74 yr and who were most likely to have occupations, and surveyed their medical and occupational histories in the early period of the DPC (FY2008), and after the spread of the DPC (FY2015).

Study design

This was a cross-sectional study.

Definition of outcomes

Figure 1 describes the definition of first admission and readmissions. Records were arranged by patient ID and included admissions of patients with no history of admission in the previous three years. Thus, patients who were discharged between April 2008 and March 2009 were defined as first admissions in FY2008. We excluded records which did not provide the current occupational status or provided unknown ICD-10 and -3 classifications, such as "Certain conditions originating in the perinatal period (P00–P96)", "Symptoms, signs, and abnormal clinical and laboratory findings (R00–R99)", and "Factors influencing health status and contact with health services (Z00–Z99)". The length of each hospital stay and the number of readmissions were both calculated for FY2008. Readmissions in FY2008 described those who were readmitted for the same ICD for the second time or more in FY2008 or in the following fiscal year, for example, being readmitted at the period of time between their first admission and March 2010. If a patient whose hospitalization was carried over from the previous year was then discharged (or died) in FY2008, information on that patient was included in the data. Similarly, for FY2015, the data from April 2015 to March 2016 were classified as either first admission or readmission, which included hospitalizations until March 2017. The average number of readmissions was calculated per patient who had been hospitalized with the same ICD category. The disease names are classified by ICD code, which makes it possible to see changes over time as well as regional trends for the same disease. Using current occupational status, we compared the major causes of admission as classified under ICD, stratified by employed and employed groups.

Statistical method

Items in the Inpatient Clinico-Occupational Survey of the Rosai Hospital Group are described in detail elsewhere[4]. Data on the number of discharges, the average length of hospital stay, the number of admissions and the standard error, and the difference per major category of ICD-10 for the first and subsequent admissions in FY2008 and FY2015 were subjected to statistical analysis using STATA 16 (Light Stone. Japan). Descriptive data were obtained (mean and standard error) for each variable. Finally, these results were stratified according to current occupation status, and the characteristics of the length of hospital stay were examined per major classification in ICD-10. The level of significance was set at $p<0.001$ (Student's t-test).

Ethics approval and consent to participate

Written consent was obtained from participants after an explanation by the survey officer regarding the medical and occupational survey that formed the basis of this study

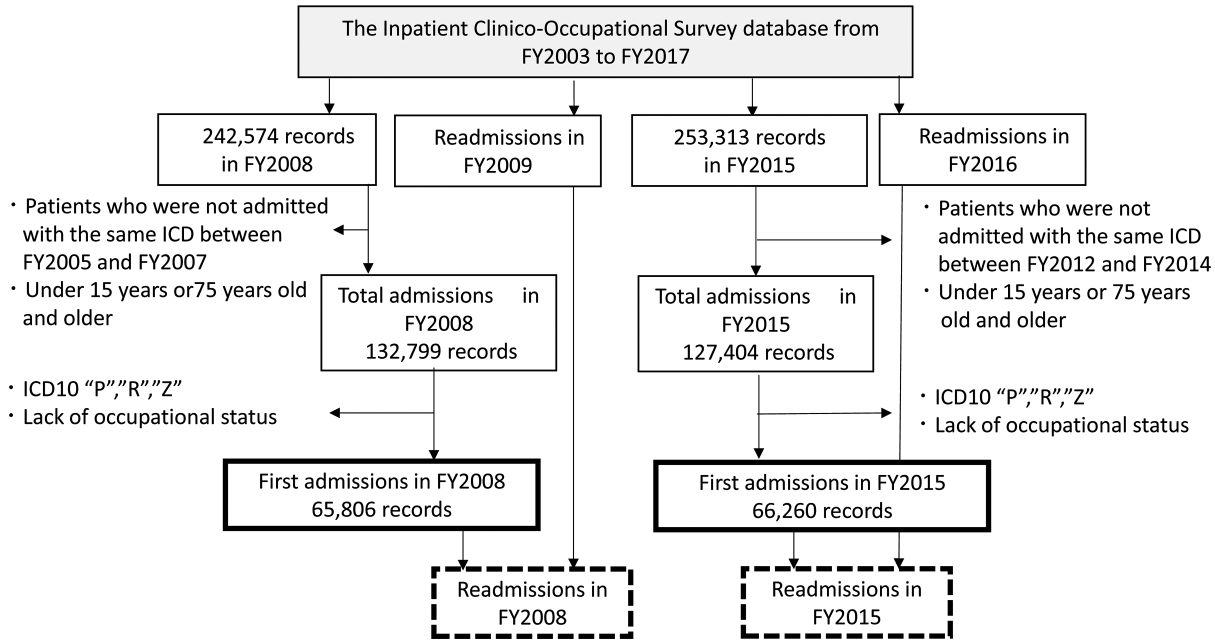

Fig. 2. Flow diagram of the data selection.

until 2015, but participants were given the option to opt out from data collection in 2016. This study was approved by the Japanese Organization of Occupational Health and Safety Ethics Committee (Protocol Number R1-006).

Results

As shown in Fig. 2, of the 132,799 records of patients aged 15–74 yr in FY2008, 65,806 (50%) first admissions were included in the study, while 66,260 (52%) subjects were included out of 127,404 records in FY2015. Table 1 shows that in FY2008, 21,947 (33%) of first admissions and 7,575 (46%) of readmissions were elderly patients aged 65–74, but in FY2015, these figures rose to 23,957 (38%) and 17,143 (59%), respectively, indicating an increasing percentage of elderly patients. Men accounted for approximately 55% of the first admissions, and there was no difference in the proportion in different hospital locations. As for readmissions, however, men accounted for approximately 61% (10,176) in FY2008 and 57% (16,610) in FY2015, accounting for a larger proportion of the patients. Although this database was provided by the nationwide Rosai Hospital Group of the Japan Organization of Occupational Health and Safety, only about 2% of patients admitted due to occupational accidents were covered by Industrial Accident Compensation Insurance. More than 50% of patients had occupations at the time of their first admission, but the rates decreased by as much as 47% in FY2008 and 31% in FY2015 at the time of their readmission. The average length of hospital stay for the first admission was 15.0 d in FY2008, compared to 12.3 d in FY2015. The average hospital stay on readmission was 17.8 d in FY2008, which decreased to 13.9 d in FY2015. The mean frequency of readmission after first admission, however, was approximately 2.8 times in both years.

Table 2 shows a comparison of the number of days admitted after the first admission in FY2008 based on the ICD-10 major classification. The longest stay was 24.8 d due to external influences, followed by 22.5 d for musculoskeletal disorders. The ICD-10 major classifications of causative disease were the same for the first admissions in FY2015, however, the length of stay for first admissions and readmissions was reduced to 20.1 d and 20.0 d in FY2015, respectively. Upon comparing the first admissions in FY2008 with those in FY2015, it was found that the conditions with the greatest reduction in length of hospital stay included congenital malformations (6.2 d, p=0.066), external influences (4.77 d, p<0.001), and mental and behavioural disorders (4.1 d, p<0.001). The length of hospital stay was reduced for all illnesses other than nervous system disorders, which was 3.2 d. Out of 17 ICD-10 major classifications in both FY2008 and FY2015, the average length of hospital stay was shorter for employed patients than for unemployed patients.

As for readmissions, one of the ICD-10 major classifications with the highest frequency of readmissions was

Table 1. Patients' characteristics upon first hospitalization and readmission in FY2008 and FY2015

		FY2008				FY2015			
		First hospitalization		Readmission		First hospitalization		Readmission	
		n=65,806	%	n=16,653	%	n= 62,260	%	n= 29,242	%
Age (yr)	15–24	3,538	5	468	3	3,309	5	872	3
	25–34	6,704	10	988	6	5,381	9	1,121	4
	35–44	7,435	11	1,176	7	7,229	12	1,694	6
	45–54	8,907	14	1,771	10	8,610	14	2,503	9
	55–64	17,283	26	4,664	28	13,774	22	5,954	20
	65–74	21,947	33	7,575	46	23,957	38	17,143	59
Sex	Male	36,419	55	10,176	61	34,118	55	16,610	57
Hospital Location	Hokkaido	4,807	7	1,246	7	4,312	7	1,575	5
	Tohoku	6,336	10	1,615	10	5,709	9	2,325	8
	Kanto	13,856	21	3,613	22	14,093	23	7,369	25
	Hokuriku/ Chubu	9,035	14	2,536	15	8,257	14	3,893	13
	Kansai	10,856	17	2,637	15	11,326	18	6,186	21
	Chugoku/ Shikoku	12,413	19	3,196	19	11,400	18	4,950	17
	Kyusyu	8,503	13	1,799	10	7,163	12	2,944	10
Industrial accident compensation Insurance	Yes	1,401	2	776	2	1,331	2	321	1
Occupation	Employed	35,553	54	16,207	47	33,973	55	9,138	31
Hospital stay (d)	mean ± SD	15.0 ± 24.5	min–max	17.8 ± 24.4	min–max	12.3 ± 30.9	min–max	13.9 ± 20.2	min–max
			0–2,212		0–658		0–3,805		0–563
Readmission (times)	mean ± SD	NA	NA	2.8 ± 1.7	2–32	NA	NA	2.8 ± 1.6	2–33

Table 2. Average length of first hospital stay between FY2008 and FY2015 based on ICD10 major classification

ICD10 major classification	ICD10 codes	FY2008		FY2015		*p*-value
		n	days*	n	days*	
Infection	A00–B99	1,656	10.8 ± 0.4	1,316	8.3 ± 0.3	<0.001
Tumor	C00–D48	12,783	15.2 ± 0.2	13,012	11.1 ± 0.2	<0.001
Blood and immune diseases	D50–D89	172	19.2 ± 1.7	187	15.5 ± 1.4	0.047
Endocrine metabolic disorders	E00–E90	2,206	16.4 ± 0.4	2,043	13.8 ± 0.2	<0.001
Mental and behavioral disorders	F00–F99	215	14.1 ± 1.2	149	9.0 ± 1.3	0.004
Nervous system disorders	G00–G99	1,793	13.5 ± 0.6	1,678	16.7 ± 2.8	0.874
Eye and appendage disorders	H00–H59	2,655	6.0 ± 0.1	3,129	3.8 ± 0.8	<0.001
Ear disorders	H60–H95	1,378	10.1 ± 0.2	1,039	8.2 ± 0.3	<0.001
Cardiovascular diseases	I00–I99	7,632	16.6 ± 0.3	6,639	14.0 ± 0.7	<0.001
Respiratory disorders	J00–J99	3,664	11.2 ± 0.4	3,449	10.3 ± 0.2	0.02
Digestive disorders	K00–K99	8,361	9.2 ± 0.1	8,343	7.4 ± 0.1	<0.001
Skin diseases	L00–L99	849	16.9 ± 1.3	712	13.4 ± 0.7	<0.001
Musculoskeletal disorders	M00–M99	7,498	22.5 ± 0.2	6,889	20.0 ± 0.3	<0.001
Renal urinary tract diseases	N00–N99	3,576	9.1 ± 0.2	3,222	7.6 ± 0.2	<0.001
Pregnancy, labour, and puerperium	O00–O99	3,152	8.2 ± 0.2	3,058	7.7 ± 0.2	0.007
Congenital malformations	Q00–Q99	195	15.3 ± 4.1	223	9.1 ± 1.1	0.066
External influences	S00–T98	7,259	24.8 ± 0.4	7,172	20.1 ± 0.3	<0.001

*Mean ± SE.

tumour, at 3.3 times in FY2008 and FY2015 (Table 3). Blood and immune diseases had the highest readmission rates at 3.5 times. The average number of readmissions was generally lower in FY2008, except for mental and behavioural disorders and eye and appendage disorders. The average length of hospital stay for readmission was shorter in FY2015 for except those readmitted due to mental and behavioural disorders (p=0.760).

Table 4 described that the average lengths of hospital stays in FY2008 and FY2015 were significantly shorter for most employed patients at the time of admission. In particular, there was a significant difference in the length of admissions between employed and unemployed patients admitted due to skin diseases (10.0 d) and nervous system disorders (8.6 d) in FY2008. Unemployed patients had significantly longer hospital stays for most diseases in FY2015, except for those admitted due to congenital malformations (2.8 d, p=0.658) and eye and appendage disorders (1.1 d, p<0.001). There was a large difference in the length of stay according to employment status in FY2015 for patients admitted with nervous system disorders (11.5 d, p<0.001) and with mental and behavioural disorders (6.0 d, p=0.008).

Discussion

This is the first study reporting the relationship between occupation and length of hospital admission during first admissions and readmissions which used the Inpatient Clinico-Occupational Survey, which has been examining the medical and occupational histories of inpatients at Rosai hospitals nationwide since 1984. Patients with occupations at the time of admission had significantly shorter lengths of stay in FY2008 upon their first admission due to skin diseases (10.1 d) or nervous system disorders (8.6 d), whereas in FY2015, hospital stays were shorter for first admissions due to nervous system disorders (11.5 d) and mental and behavioural disorders (6.0 d). Therefore, the promotion of health and employment support for patients who might be forced to leave the hospital early due to work commitments should be considered in the occupational settings to age. Of the total study population, 33% were in FY2008 and 39% in FY2015 were patients aged 65–74 yr old; therefore, aging might influence both the length of hospital stays and number of readmissions. Among the 67.2 million people comprising the labour force in Japan in 2018, 4.54 million were 65–69 yr old and 3.67 million were 70 yr or older, and the rate of those 65 yr or older continued to rise until they comprised 12.2% of the labour force[9].

Appropriate length of stay and admission are considered important indicators of efficient healthcare delivery in hospitals[17, 18]. Awad *8.* reported that the length of stay may be used as a parameter for mortality and healthcare resource utilization[19]. This study conducted in Japan had access to approximately 3.67 million registered information items as of March 2019, and since the medical history database includes one of the largest occupational history databases, the study has provided evidence that employment status might have an influence on the length of stay. Another strength of the study lies in the improved accuracy of the data and in the fact that it has employed a large-scale comparative analysis of 65,806 people in FY2008 before the introduction of the DPC, and 62,260 people for the latest data in FY2015. The average length of hospital stay based on hospital reports is an approximate number, estimated based on the total number of hospitalized patients per year 1/2 × (number of new hospitalized patients + number of patients discharged annually)[5]. The DPC/Per-Diem Payment System (PDPS) database was not adequate for estimating the length of hospital stay because it did not include Day 0 of hospitalization for the purpose of calculating a fixed fee per day based on the classification of the diagnosis group. The significance of this study is that using the Inpatient Clinico-Occupational Survey, which includes day surgery admissions, enabled a detailed analysis of the diagnosis upon first admissions and readmissions for the same ICD-10 classifications, excluding duplications, based on the data of 33 Rosai hospitals nationwide. In particular, the analysis, which was based on employment status taken from the occupational history survey in this database, revealed that patients with an occupation had a shorter length of hospital stay for most diseases, with the difference in the lengths being especially large for nervous system disorders (11.5 d) and for mental and behavioural disorders (6.0 d) in FY2015. It is difficult to examine the relationship between hospital reports and occupations; such a large-scale database that enables the detailed analysis of occupational history is unique in Japan.

However, in this study, first admission was defined as having no previous admissions logged in this database within the past three years, while readmission was defined as repeated admission with the same diagnosis until the next fiscal year. Therefore, it is possible that some cases were misclassified, wherein patients had different ICD-10 codes upon readmission during the following administration. In addition, while the medical histories included all variables from the summary at discharge, the response

Table 3. Average number of readmissions between FY2008 and FY2015 based on ICD10 major classification

ICD10 major classification	Numbers of patients		Average number of readmissions*			Average length of readmission*		
	FY2008	FY2015	FY2008	FY2015	*p* value	FY2008	FY2015	*p*-value
Infection	383	441	2.6 ± 0.1	2.8 ± 0.1	0.969	15.1 ± 0.9	14.8 ± 1.1	0.416
Tumor	4,307	7,408	3.3 ± 0.0	3.3 ± 0.0	0.838	22.8 ± 0.4	17.0 ± 0.3	<0.001
Blood and immune diseases	87	153	3.2 ± 0.2	3.5 ± 0.2	0.882	17.4 ± 3.0	15.4 ± 1.1	0.276
Endocrine metabolic disorders	418	785	2.6 ± 0.1	2.8 ± 0.0	0.999	19.3 ± 1.0	16.4 ± 0.6	0.004
Mental and behavioral disorders	43	61	2.7 ± 0.1	2.6 ± 0.1	0.308	15.5 ± 2.8	19.3 ± 4.0	0.76
Nervous system disorders	540	802	2.5 ± 0.0	2.6 ± 0.0	0.817	16.4 ± 1.0	15.7 ± 1.1	0.312
Eye and appendage disorders	692	2,735	2.4 ± 0.0	2.3 ± 0.0	<0.001	6.1 ± 0.3	2.2 ± 0.1	<0.001
Ear disorders	183	210	2.4 ± 0.0	2.4 ± 0.0	0.356	9.1 ± 0.5	7.6 ± 0.6	0.028
Cardiovascular diseases	2,480	3,949	2.8 ± 0.0	2.9 ± 0.0	0.999	14.1 ± 0.5	11.2 ± 0.3	<0.001
Respiratory disorders	793	1,341	2.8 ± 0.0	3.1 ± 0.0	1	18.8 ± 1.0	17.3 ± 0.7	0.126
Digestive disorders	2,056	3,553	2.6 ± 0.0	2.8 ± 0.0	0.998	12.2 ± 0.3	11.0 ± 0.3	0.004
Skin diseases	202	340	2.6 ± 0.1	2.8 ± 0.1	0.969	24.5 ± 2.5	21.1 ± 1.5	0.107
Musculoskeletal disorders	1,787	2,853	2.3 ± 0.0	2.4 ± 0.0	0.777	26.1 ± 0.5	23.0 ± 0.3	<0.001
Renal urinary tract diseases	914	1,608	2.7 ± 0.0	2.9 ± 0.0	0.999	11.6 ± 0.6	10.9 ± 0.3	0.125
Pregnancy, labour, and puerperium	627	863	2.2 ± 0.0	2.2 ± 0.0	0.378	8.0 ± 0.4	6.6 ± 0.2	<0.001
Congenital malformations, etc.	35	74	2.2 ± 0.1	2.5 ± 0.1	0.92	20.5 ± 5.5	9.4 ± 1.3	0.005
External influences	1,106	2,051	2.4 ± 0.0	2.5 ± 0.0	0.988	22.7 ± 1.0	16.7 ± 0.5	<0.001

*Mean ± SE.

Table 4. Average length of first hospital stay based on ICD10 major classification stratified by employed status

ICD10 major classification	First hospital stay in FY2008*					First hospital stay in FY2015*				
	Employed		Unemployed			Employed		Unemployed		
	n	days	n	days	*p* value	n	days	n	days	*p*-value
Infection	962	9.8 ± 9.0	694	12.1 ± 20.4	0.129	795	7.2 ± 8.6	521	10.0 ± 16.0	0.002
Tumor	7,046	14.3 ± 10.6	5,737	16.4 ± 12.5	<0.001	7,158	10.0 ± 19.0	5,854	12.5 ± 24.0	<0.001
Blood and immune diseases	87	16.0 ± 16.7	83	22.4 ± 26.8	0.146	107	13.8 ± 10.6	80	17.7 ± 11.3	0.044
Endocrine metabolic disorders	1,126	12.4 ± 13.1	1,080	18.9 ± 26.5	<0.001	1,092	13.2 ± 14.4	951	14.5 ± 10.6	0.004
Mental and behavioral disorders	110	12.4 ± 13.1	105	15.8 ± 21.7	0.498	76	6.1 ± 10.6	73	12.1 ± 18.8	0.008
Nervous system disorders	1,012	9.7 ± 17.1	781	18.3 ± 32.8	<0.001	974	11.9 ± 67.5	704	23.4 ± 160.9	<0.001
Eye and appendage disorders	1,062	6.2 ± 6.0	1,593	5.8 ± 5.3	0.266	1,269	4.4 ± 5.0	1,860	3.3 ± 3.9	<0.001
Ear disorders	827	10.2 ± 8.5	551	9.9 ± 7.7	0.32	631	7.8 ± 5.0	408	8.9 ± 15.4	0.902
Cardiovascular diseases	3,735	15.1 ± 22.7	3,897	18.1 ± 37.2	<0.001	3,437	12.5 ± 17.9	3,202	15.5 ± 74.0	0.012
Respiratory disorders	2,250	9.3 ± 8.1	1,424	14.5 ± 35.3	<0.001	2,085	8.3 ± 10.2	1,364	13.4 ± 19.0	<0.001
Digestive disorders	4,944	4.7 ± 6.4	3,417	10.2 ± 13.7	<0.001	4,995	6.8 ± 7.7	3,348	8.2 ± 11.5	<0.001
Skin diseases	514	12.9 ± 20.1	335	23.0 ± 57.9	<0.001	416	12.1 ± 10.6	296	14.3 ± 10.6	0.004
Musculoskeletal and connective tissue disorders	4,178	20.2 ± 19.2	3,320	25.4 ± 22.3	<0.001	3,746	17.8 ± 18.0	3,143	21.6 ± 26.1	<0.001
Renal urinary tract diseases	2,006	7.6 ± 11.0	1,570	11.1 ± 15.4	<0.001	1,904	6.3 ± 7.2	1,316	9.5 ± 12.7	<0.001
Pregnancy, labour, and puerperium	1,157	8.0 ± 9.5	1,995	8.4 ± 8.9	0.002	1,600	7.4 ± 8.3	1,458	8.0 ± 9.1	<0.001
Congenital malformations, etc.	120	16.9 ± 72.3	75	12.5 ± 17.3	0.401	148	10.1 ± 18.5	75	7.3 ± 9.3	0.658
External influences	4,523	24.3 ± 31.6	2,736	25.7 ± 51.4	0.177	4,396	19.5 ± 23.1	2,776	20.9 ± 32.8	0.003

*Mean ± SD.

rate from patients and families regarding occupational history data was 88%[4]; thus, there are limitations in terms of response rate and accuracy. Another limitation is that although the authors of this study only assessed this according to the ICD-10 code, the length of hospital stay may vary due to complex factors, such as those involving different processes in medical practice, individual seriousness, or health conditions.

The length of stay during the first admission and number of readmissions based on ICD-10 classification have been compared for the first time using the largest occupational history survey in Japan. Because patients with jobs were likely to have a shorter hospital stay, it is vital to provide support for patients and to aid in the promotion of health and employment after returning to work for those with diseases requiring repeated admissions, such as cardiovascular disease and respiratory disease. Occupational professionals should be aware that patients who require repeated readmission are increasing, even if the length of stay upon the first admission is shortened, especially for elderly workers with disease.

Conflict of Interest

The authors declare no competing financial interests.

Author Contributions

N.K. conceived the original idea and wrote the manuscript. A.T. supervised the project. All co-authors critically reviewed and edited the manuscript. All authors have read and approved the final manuscript.

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References

1) Bueno H, Ross JS, Wang Y, Chen J, Vidán MT, Normand SL, Curtis JP, Drye EE, Lichtman JH, Keenan PS, Kosiborod M, Krumholz HM, Krumholz HM (2010) Trends in length of stay and short-term outcomes among Medicare patients hospitalized for heart failure, 1993–2006. JAMA **303**, 2141–7. [Medline] [CrossRef]
2) Rotter T, Kinsman L, James E, Machotta A, Gothe H, Willis J, Snow P, Kugler J (2010) Clinical pathways: effects on professional practice, patient outcomes, length of stay and hospital costs. Cochrane Database Syst Rev **3**, CD006632. [Medline]
3) Baek H, Cho M, Kim S, Hwang H, Song M, Yoo S (2018) Analysis of length of hospital stay using electronic health records: a statistical and data mining approach. PLoS One **13**, e0195901. [Medline] [CrossRef]
4) Japan Organization of Occupational Health and Safety Inpatient Clinico-Occupational Survey Summary. https://www.research.johas.go.jp/bs/doc/bsenglish.pdf. Accessed October 8, 2020.
5) OECD Length of hospital stay (indicator). https://data.oecd.org/healthcare/length-of-hospital-stay.htm. Accessed October 8, 2020.
6) Director-General for Statistics, Information Policy, and Policy Evaluation Ministry of Health, Labour and Welfare Handbook of Health and Welfare Statistics 2018. https://www.mhlw.go.jp/english/database/db-hh/ Accessed October 8, 2020.
7) Fushimi K, Hashimoto H, Imanaka Y, Kuwabara K, Horiguchi H, Ishikawa KB, Matsuda S (2007) Functional mapping of hospitals by diagnosis-dominant case-mix analysis. BMC Health Serv Res **7**, 50. [Medline] [CrossRef]
8) Act on Stabilization of Employment of Elderly Persons Act No. 68 (1971) http://www.japaneselawtranslation.go.jp/law/detail/?id=2621&vm=&re=02. Accessed October 8, 2020.
9) Cabinet Office Japan Annual Report on the Ageing Society [Summary] FY 2019. https://www8.cao.go.jp/kourei/english/annualreport/2019/pdf/2019.pdf. Accessed October 8, 2020.
10) Zaitsu M, Kato S, Kim Y, Takeuchi T, Sato Y, Kobayashi Y, Kawachi I (2019) Occupational class and risk of cardiovascular disease incidence in Japan: nationwide, multi-center, hospital-based case-control study. J Am Heart Assoc **8**, e011350. [Medline] [CrossRef]
11) Kaneko R, Zaitsu M, Sato Y, Kobayashi Y (2019) Risk of cancer and longest-held occupations in Japanese workers: a multicenter hospital-based case-control study. Cancer Med **8**, 6139–50. [Medline] [CrossRef]
12) Zaitsu M, Kaneko R, Takeuchi T, Sato Y, Kobayashi Y, Kawachi I (2018) Occupational inequalities in female cancer incidence in Japan: hospital-based matched case-control study with occupational class. SSM Popul Health **5**, 129–37. [Medline] [CrossRef]
13) Ministry of Internal Affairs and Communications (in Japanese). https://www.soumu.go.jp/toukei_toukatsu/index/seido/sangyo/H25index.htm. Accessed October 8, 2020.
14) Ministry of Internal Affairs and Communications (in Japanese). https://www.soumu.go.jp/toukei_toukatsu/index/seido/shokgyou/21index.htm. Accessed October 8, 2020.
15) World Health Organization, International Statistical Classification of Diseases and Related Health Problems 10th Revision (2019) https://www.who.int/classifications/icd/icdonlineversions/en/. Accessed October 8, 2020.

16) Centers for Disease Control and Prevention International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) (2011) https://www.cdc.gov/nchs/icd/icd9cm.htm. Accessed October 8, 2020.
17) Jeddian A, Afzali A, Jafari N (2017) Evaluation of appropriateness admission and hospital stay at educational hospital. Arch Iran Med **20**, 16–21. [Medline]
18) Clarke A (2002) Length of in-hospital stay and its relationship to quality of care. Qual Saf Health Care **11**, 209–10. [Medline] [CrossRef]
19) Awad A, Bader-El-Den M, McNicholas J (2017) Patient length of stay and mortality prediction: a survey. Health Serv Manage Res **30**, 105–20. [Medline] [CrossRef]