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## Preliminary Reports

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# Exploring the Effect of Outpatient Cardiac Rehabilitation on Prevention of Short-term Re-admission: A Hospital-based Study in Fukushima, Japan

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**Objective:** This hospital-based study examined whether outpatient cardiac rehabilitation (CR) prevents cardiac-related re-admission within 6 months.

**Method:** Clinical records of Japanese cardiac disease patients who were hospitalized and recommended for cardiac rehabilitation at a general hospital were analyzed by comparing data from 78 outpatient CR (OCR) participants with data from 179 randomly selected non-participants.

**Results:** OCR significantly prevented cardiac-related re-admission (odds ratio: 0.24; 95% confidence interval: 0.06–0.91) after controlling for sex and OCR participation-associated factors.

**Conclusion:** OCR participation may improve short-term prognosis. The positive effects of OCR should be promoted to increase participation.

**Keywords:** cardiovascular disease, rehabilitation, patient participation, prevention, patient re-admission

### Introduction

Cardiac rehabilitation (CR) is a professionally supervised program consisting of exercise and lifestyle instructions for patients recovering from cardiovascular diseases and surgeries.<sup>1</sup> It is highly effective for

increasing exercise tolerance, preventing recurrence of cardiovascular events, improving quality of life, and improving long-term prognosis.<sup>1–3</sup>

There are numerous studies outside of Japan reporting positive effects of outpatient CR (OCR) after a follow-

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up of more than 2 years.<sup>3</sup> However, few studies have confirmed the short-term effects of OCR participation. The present study examined effects of OCR participation among Japanese patients after 6 months by setting cardiac-related hospital re-admission as the outcome indicator. This hospital-based study examined the short-term effects of OCR and may aid in developing strategies with a realistic goal to promote OCR participation further among Japanese patients.

## Methods

This was a hospital-based retrospective cohort study, which used data derived from electronic medical charts and a cardiac catheterization database from a tertiary general hospital, Ohta-Nishinouchi Hospital in Fukushima Prefecture, Japan. During the study period (March 2010 to February 2012), 544 patients were hospitalized for ischemic heart disease (including acute myocardial infarction and angina pectoris), heart failure, or open-heart surgery, and were recommended for hospitalized CR. Our OCR program is consistent with the Japanese Circulation Society (JCS) guidelines: one hour of therapeutic exercise, including warming up, aerobic exercise, and cooling down, carried out under the supervision of trained cardiac rehabilitation instructors. This is combined with lifestyle guidance by a cardiovascular specialist and the same cardiac rehabilitation instructors.

For evaluating OCR effects, we analyzed data from 196 patients enrolled in our previously reported case-controlled study<sup>4</sup> and followed up for 6 months in order to investigate cardiac-related re-admission. It should be noted that our database did not include re-admissions outside our care unit (which included non-cardiac events and admissions to other hospitals). We first defined 78 patients who were prescribed in-hospital CR and continued to participate in OCR after discharge as OCR participants. We randomly selected 179 patients as controls from among patients who did not participate in OCR.<sup>4</sup> Among them, 74 participants and 122 non-participants completed 6 months of follow-up, and their data were analyzed in the present study.

The following information was analyzed in the present study: baseline characteristics (age, sex, employment status, family structure, and distance between the

residence and hospital), major diagnosis, coronary risk factors (hypertension, dyslipidemia, diabetic mellitus, and smoking history), and cardiac-related re-hospitalization within 6 months.

First, we compared patients who were re-admitted and those who were not re-admitted to assess factors associated with re-admission. Univariate analyses compared these groups using the Chi-square test for categorical variables and the Mann-Whitney U test for continuous variables. In order to assess the impact of OCR participation on short-term re-admission, we first performed a multivariate logistic regression analysis (Model 1) entering OCR participation and other factors that were significant in univariate analysis (**Table 1**). Second, we performed a multivariate logistic regression analysis (Model 2) including factors that we previously reported to be associated with OCR participation,<sup>4</sup> and were not included in the Model 1; namely age and sex. Analyses were performed using SPSS statistical software version 17.0 for Windows (IBM SPSS, Inc., Chicago, IL, USA).

Our study protocol was approved by the ethics committee of Fukushima Medical University (No. 1465) and Ohta-Nishinouchi Hospital. All data were collected without reference to the patients' identification information.

## Results

Among 196 patients followed for 6 months (74 OCR participants and 122 controls), 27 patients were re-admitted to the hospital for cardiac complications (4 OCR participants and 23 controls). As presented in **Table 1**, OCR participation was significantly associated with a decreased risk of cardiac-related re-admission. Unemployment, a longer distance between the patient's residence and the hospital, and heart failure diagnosis were associated with an increased risk of cardiac-related re-admission. In the multivariate analysis with all the significant variables (Model 1) and the previously reported OCR participation-related factors (Model 2), OCR participation significantly reduced cardiac-related re-admission (odds ratio [OR] = 0.24, 95% confidence interval [CI] = 0.07–0.88,  $p = 0.032$ ), with an  $R^2$  of 0.15 (**Table 2**).

**Table 1. Baseline characteristics stratified by cardiac-related re-admission**

	N (%) or Median (range)		p
	Re-admitted (N = 27)	Not re-admitted (N = 169)	value†
Age	69.0 (54–94)	67.0 (18–93)	0.09
Sex (male)	18 (66.7)	114 (67.5)	0.94
Body mass index (kg/m <sup>2</sup> )	22.8 (14.6–33.3)	23.7 (14.4–40.0)	0.67
Employed (yes)	5 (18.5)	65 (38.5)	0.045*
Family structure (living alone)	5 (18.5)	16 (9.8)	0.18
Distance from home to hospital (km)	15 (0.6–59.6)	6.1 (0.3–116.6)	0.047*
OCR participation	4 (14.8)	70 (41.7)	0.014*
Physician's specialty (internal medicine)	16 (59.3)	87 (51.5)	0.22
Coronary risk factor (present)			
Hypertension	20 (74.1)	118 (71.5)	0.78
Diabetic mellitus	7 (25.9)	51 (30.7)	0.61
Dyslipidemia	9 (33.3)	73 (45.1)	0.26
Smoking	7 (29.2)	75 (48.4)	0.08
Major diagnosis			
IHD	8 (30.3)	79 (46.7)	0.13
Heart failure	9 (34.6)	20 (11.8)	0.002*
Cardiac function			
Ejection fraction (%)	54 (29–79)	56 (23–85)	0.22
Sleeping pills and/or antidepressants	5 (19.2)	50 (30.1)	0.25

**Table 1** shows characteristics of re-admitted and not re-admitted patients within six months.

†The Chi-squared test was used for categorical variables and the Mann-Whitney U test was used for continuous variables.

\*p < 0.05 was considered significant.

CR, cardiac rehabilitation; IHD, ischemic heart disease

## Discussion

This study showed that OCR participation among our cohort prevented re-hospitalization within 6 months, which is useful data for encouraging cardiovascular patients to enroll in OCR.

Hernandez and colleagues reported that re-admission of

**Table 2. Effects of outpatient cardiac rehabilitation (OCR) participation on cardiac-related re-admission within 6 months**

	MODEL 1 adjusted for significant variables in <b>Table 1</b>		MODEL 2 adjusted for significant variables in <b>Table 1</b> and relevant OCR participation factors	
	Odds ratio	95% CI	Odds ratio	95% CI
OCR participation				
NO	1.0		1.0	
YES	0.24	0.07– 0.88*	0.24	0.06– 0.91*

\*p < 0.05

Regression model 1 was adjusted for employment (OR = 0.64, 95% CI = 0.22–1.93), distance to hospital (OR = 1.0, 95% CI = 0.98–1.03), OCR participation (OR = 0.24, 95% CI = 0.07–0.88), and heart failure (OR = 3.33, 95% CI = 1.26–8.83). R<sup>2</sup> = 0.15

Model 2 was also adjusted for significant variables in **Table 1** and relevant OCR participation factors such as; employment (OR = 0.63, 95% CI = 0.16–2.37), distance to hospital (OR = 1.0, 95% CI = 0.98–1.03), OCR participation (OR = 0.24, 95% CI = 0.06–0.91), and heart failure (OR = 3.23, 95% CI = 1.17–8.90) and previously reported relevant OCR participation factors: age (OR = 1.0, 95% CI = 0.96–1.05) and sex (OR = 0.68, 95% CI = 0.25–1.83). R<sup>2</sup> = 0.15

CI, confidence interval.

heart failure patients occurs with a high frequency during the early phase after discharge<sup>5</sup> and recommend early outpatient check-ups. OCR participation could create a good motive and opportunity for such an early hospital visit.<sup>6–8</sup> Although OCR is covered by insurance in Japan, its participation rate is lower than those reported in other countries.<sup>9</sup> More accessible information regarding the positive short-term impact of OCR and more personalized recruitment strategies, particularly for patients with barriers identified by Endo et al<sup>4</sup> (older age and a longer distance between the patient's residence and the hospital) are recommended.

This study had three major methodological limitations that suggest the need for further research. First, this was a single-center study with a limited number of cases. Second, the data were collected retrospectively, and some important determinants (e.g., socioeconomic status, blood tests, cardiac function, and psychological measures) for preventing re-admission may not have been available, resulting in a low  $R^2$  value. Short-term re-admission in particular is influenced by various medical conditions. Obtained results should be confirmed in various clinical settings and by controlling for more variables, including those listed above. Third, OCR compliance records were not analyzed, and possible mechanisms for the immediate positive impacts of OCR were not clear. Our study site implements a program with elements that are common throughout Japan. There is a need to determine whether there are specific characteristics of our program that are more effective and the mechanisms by which they improve patient outcomes.

### **Conclusion**

Participation in OCR may improve short-term patient prognosis. The positive effects of OCR should be promoted to patients to increase participation.

**Declaration of conflicts of interest:** None.

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