Attendance rates and outcomes of cardiac rehabilitation in Victoria, 1998

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ABSTRACT

Objective: To describe the patterns of use of cardiac rehabilitation in Victoria and to assess whether the survival benefits predicted in clinical trials have been realised in the community.

Design: Cohort study based on data linkage.

Participants: All patients admitted for acute myocardial infarction (AMI), coronary artery bypass grafting (CABG) or percutaneous transluminal coronary angioplasty (PTCA) in Victoria in 1998 ($n = 12\,821$).

Interventions: Attendance at one of 66 participating outpatient cardiac rehabilitation centres in Victoria.

Main outcome measures: Rates of attendance at rehabilitation based on key factors such as diagnosis, age, sex, and comorbidity. Five-year survival for attendees compared with non-attendees.

Results: Rates of participation in rehabilitation were 15% for AMI, 37% for CABG, and 14% for PTCA. Rehabilitation attendance rates dropped sharply after 70 years of age. Attendees had a 35% improvement in 5-year survival (hazard ratio for death associated with rehabilitation attendance, 0.65 [95% CI, 0.56–0.75]).

Conclusions: Attendance rates at cardiac rehabilitation are suboptimal, even though attendance confers a clinically significant difference in 5-year survival. The elderly, women, and those with comorbid conditions may benefit measurably from increased rates of attendance.

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CARDIOVASCULAR DISEASE is the leading cause of death in Australia, causing more than 40% of all deaths in 1998.[1]

Cardiac rehabilitation programs aim to help participants achieve lifestyle changes that will modify risk factors, using a combination of exercise, education, counselling and support. Systematic literature reviews of randomised controlled trials assessing the benefits of cardiac rehabilitation have shown that patients attending rehabilitation after myocardial infarction have a 25% decrease in all-cause mortality.[2,3] Most participants in these trials were men under 65 years of age, and follow-up varied between 1 and 5 years.

Current recommendations suggest that cardiac rehabilitation should be offered to all patients after cardiac surgery or acute myocardial infarction.[4] Studies assessing cardiac rehabilitation attendance rates are few, and are local rather than population-based. A cross-sectional study in the United States found 11% attendance at rehabilitation after myocardial infarction, compared with 23% attendance after cardiac bypass.[5] Women and individuals over the age of 65 were poor attendees.[5] An Australian pilot study, which was based on data linkage using attendance records from rural hospital-based programs and the state hospital morbidity database, found rates of participation double those of the US study, but was limited in scope.[6]

Our aim was to develop a prospective, anonymised, population-based data collection of cardiac rehabilitation attendance from throughout Victoria, and (1) calculate cardiac rehabilitation attendance as a proportion of cardiac events, and (2) compare survival rates between attendees and non-attendees and with published survival rates.

METHODS

Data sources

Box 1 shows the databases used and the linkages performed for data extraction.

The Victorian Cardiac Rehabilitation Dataset is based on attendance data collected from 66 outpatient cardiac rehabilitation programs for the 12 months January to December 1998. For the purposes of this study, participation was defined as attending at least one session of a rehabilitation program. We estimate that 75% of these attendees completed a full 6–8-week program.

The Victorian Admitted Episodes Dataset (VAED) is a minimum dataset of acute public and private hospital separations throughout Victoria.[7] This is an anonymous case-based dataset useful for longitudinal hospital admission follow-up. For each hospital separation, there are 12 diagnosis fields (ICD-9-CM)[8] and 12 procedure fields. Data can be grouped to link episodes of care for each individual within the healthcare system.

The Victorian Deaths Registry contains information on all deaths in Victoria, including cause of death.

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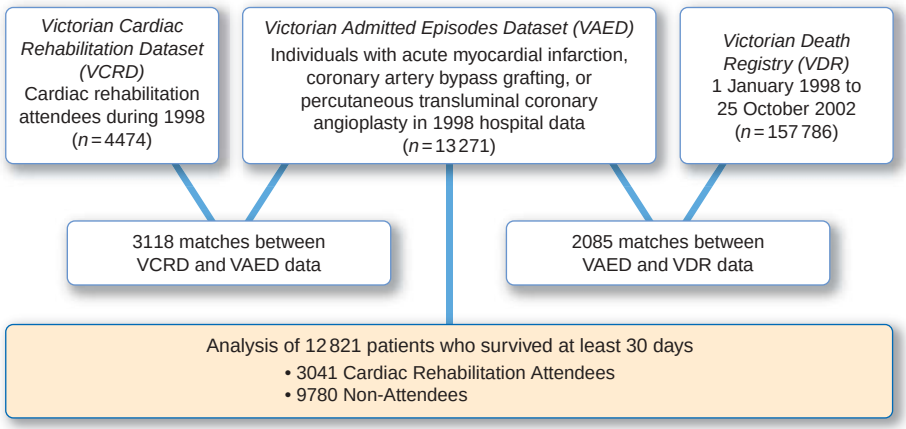
1: Linkage of the datasets



Selection of cases

From the 1998 VAED, all cases with the appropriate ICD-9 code in the first three diagnostic or procedure fields (acute myocardial infarction [AMI; ICD-9-CM code 410XX], coronary artery bypass grafting [CABG; ICD-9-CM code 361XX], percutaneous transluminal coronary angioplasty [PTCA; ICD-9-CM code 360XX]) were identified. The diagnostic codes also needed to be a primary reason for the hospital separation.

Linkage of the datasets

The data for the cases with cardiac diagnoses and the data for the cardiac rehabilitation attendees were linked using a linkage algorithm developed specifically for the two datasets. After this, the cardiac cases were linked to the deaths in Victoria between 1 January 1998 and 25 October 2002 (the latest data available from the death registry at the time of linkage).

Linkage of these datasets was required as none had a unique identifier which could connect them. Variables such as Medicare number, date of birth, sex, postal code, country of birth and first three letters of first name were used to match the datasets. After linkage across the three datasets, an identification number was created that was not based on any of the preceding variables.

Cardiac rehabilitation attendance

The cardiac rehabilitation attendance rate was based on the number of cardiac cases from the VAED sample linked to the rehabilitation dataset. Only cases from the VAED linked to the rehabilitation dataset were considered in the numerator of the attendance rate.

Survival time

Death within the follow-up period was identified if the patient (1) had an in-hospital death, as detailed in their VAED hospital separation, or (2) matched a record from the death registry.

Survival time for patients dying within the follow-up interval was defined as the time in days from the date of first cardiac diagnosis admission to either the separation date for an in-hospital death or the death date from the death registry.

Survival time for patients living throughout the follow-up was defined as the time from their first cardiac diagnosis to 25 October 2002.

Ethics approval

Approval from the Department of Human Services Ethics Committee was obtained before data linkage and analysis.

Statistical analysis

Bivariate analyses were performed between attendance at cardiac rehabilitation and various characteristics of patients. Subsequently, a multiple logistic regression model was fitted with rehabilitation attendance status as the outcome.

To assess whether there was a difference in survival between cardiac rehabilitation attendees and non-attendees, stratified Kaplan–Meier survival analyses were calculated. These were repeated for subjects who had survived the first year beyond their cardiac diagnosis or procedure. To assess survival benefit after adjusting for the covariates that were related to attendance at cardiac rehabilitation, a Cox proportional hazards model was fitted.

All analyses were conducted using SAS 8.2.[9]

RESULTS

Linkage of datasets

Seventy per cent (3118/4474) of the cardiac rehabilitation attendees were matched to VAED data (Box 1). The attendees not matched to the VAED did not differ in age or sex from those who did match. (The 1998 rehabilitation attendance dataset included those not represented in 1998 VAED data, as their cardiac event and acute admission occurred late in 1997, and those who attended rehabilitation in Victoria after hospitalisation in another state.) There were 2085 deaths from the initial 13 271 patients with AMI, CABG, or PTCA. Only data for the 12 821 patients who survived at least 30 days after their initial hospitalisation were retained for further analysis.

Although there is no record of known links among these datasets to which we could compare our matches, we were able to estimate the false positive rate for the VAED–death registry linkage based on the time sequence between the date of cardiac diagnosis or procedure and the ascribed date of death in linked records. There were no links in which this time sequence was incorrect, indicating a low false positive rate.

Cardiac rehabilitation attendance

Rates of attendance varied by cardiac diagnosis and procedure. Attendance rates peaked in the 50–59-year age group at 29% and declined after the age of 70 years. Box 2 shows the factors that also influenced attendance. In a multiple logistic regression model (Box 2), age and cardiac diagnosis or procedure were the strongest predictors of attendance, although other factors reached statistical significance.

Association between cardiac rehabilitation and 5-year survival

During follow-up, 243 (8%) of the 3041 cardiac rehabilitation attendees died, compared with 1858 (19%) of the 9780 non-attendees.

At 5 years after an initial cardiac diagnosis or procedure, there was a significant difference between attendees and non-attendees in the probability of survival (Box 3). This difference narrowed when subjects dying in the first year were excluded from the Kaplan–Meier analysis, but remained statistically significant. Adjusting for potential measured confounders with a proportional hazards model revealed that attendance at cardiac rehabilitation showed a difference in survival of 35% (adjusted hazard ratio [HR], 0.65; 95% CI, 0.56–0.75). The survival difference remained when limiting the analysis to patients who survived the first year (HR, 0.70; 95% CI, 0.60–0.82).

DISCUSSION

Our analysis brought together three diverse datasets to provide insight into attendance rates at cardiac rehabilitation after major cardiac events and the benefit of such participation in terms of survival. In the sample of 12 821 patients with AMI, CABG or PTCA, 24% attended cardiac rehabilitation. This attendance rate is similar to that identified in other studies, but remains poor in terms of uptake of a potentially beneficial therapy. Reasons for poor uptake were not identified in this study and require investigation.

A sharp decline in attendance occurred after the age of 70 years, despite the fact that 45% of our sample were over this age. Women also attended less often, even after controlling for other factors. Admission to a teaching or private hospital also appeared to be related to better attendance.

Attendance at cardiac rehabilitation was associated with a difference in survival in our analysis. This association was stronger than that found in randomised controlled trials and existed across all groups, including the elderly and patients with comorbidities.

Our analysis was subject to information bias due to misclassification. The linkage rate between the VAED and cardiac rehabilitation datasets was 70%, so up to 30% of those who attended cardiac rehabilitation could have been misclassified as non-attendees. (The cardiac rehabilitation dataset includes attendees referred for indications other than AMI, CABG or PTCA [eg, angina and post-cardiac catheterisation].) This suggests that

2: Characteristics of patients attending cardiac rehabilitation, and results of multiple logistic regression

		Total number	Number attending cardiac rehabilitation (%)	Odds ratio (95% CI)
Entire sample		12 821	3041 (24%)	
Age (years)	40–49	1 065	275 (26%)	1.00
	50–59	2 435	701 (29%)	1.06 (0.89–1.25)
	60–69	3 802	1065 (28%)	1.02 (0.86–1.20)
	70–79	3 986	878 (22%)	0.79 (0.66–0.93)
	80–89	1 394	121 (9%)	0.37 (0.29–0.48)
	⩾ 90	139	1 (1%)	0.04 (0.01–0.28)
Sex	Male	8 991	2327 (26%)	1.11 (0.99–1.25)
	Female	3 830	714 (19%)	1.00
Marital status	Currently married	9 047	2411 (27%)	1.00
	Never married	720	147 (20%)	0.77 (0.63–0.93)
	Previously married	2 671	426 (16%)	0.77 (0.68–0.87)
	Unknown	383	57 (15%)	0.52 (0.38–0.69)
Cardiac diagnosis or procedure	AMI	4 213	612 (15%)	1.00
	AMI + PTCA	1 243	357 (29%)	1.59 (0.36–1.86)
	AMI + CABG	719	304 (42%)	3.35 (2.81–4.00)
	CABG alone	3 438	1282 (37%)	2.63 (2.29–3.01)
	CABG + PTCA	100	51 (51%)	3.93 (2.60–5.96)
	PTCA alone	3 108	435 (14%)	0.65 (0.56–0.76)
Number of comorbid conditions*	0 or 1	9 249	2405 (26%)	1.00
	2 or more	3 572	636 (18%)	0.82 (0.72–0.93)
Congestive cardiac failure	No	11 026	2777 (25%)	1.00
	Yes	1 795	264 (15%)	0.78 (0.66–0.92)
Index admission to intensive care unit	No	9 404	2094 (22%)	1.00
	Yes	3 417	947 (28%)	1.01 (0.92–1.12)
Index admission classified as emergency	No	6 175	1564 (25%)	1.00
	Yes	6 646	1477 (22%)	1.40 (1.25–1.56)
Type of hospital for index admission	Teaching hospital	7 055	1762 (25%)	1.00
	Private hospital	3 585	958 (27%)	1.32 (1.17–1.48)
	Other†	2 181	321 (15%)	0.65 (0.56–0.75)
Accessible geographic place of residence‡	No	2 477	489 (20%)	1.00
	Yes	10 344	2552 (25%)	1.28 (1.13–1.45)
Lowest quartile of economic resources§	No	11 482	2841 (25%)	1.00
	Yes	1 339	200 (15%)	0.65 (0.55–0.77)

AMI = Acute myocardial infarction. CABG = Coronary artery bypass grafting. PTCA = Percutaneous transluminal coronary angioplasty. * Charlson–Deyo comorbidity index.[10,11] † Other hospital type includes Area, Large Regional, Local and Regional General hospitals. ‡ Corresponds to Accessibility/Remoteness Index of Australia (ARIA) score 0–1.84.[12] § Socioeconomic Indexes for Areas.[13]

3: Survival for attendees and non-attendees of cardiac rehabilitation programs

Survival time (years)	Probability of survival (95% CI)	
	Non-attendees	Attendees
All patients		
0	1.000	1.000
1	0.943 (0.939–0.948)	0.985 (0.981–0.989)
2	0.903 (0.898–0.909)	0.965 (0.959–0.972)
3	0.866 (0.859–0.872)	0.953 (0.945–0.96)
4	0.833 (0.826–0.84)	0.933 (0.924–0.941)
5	0.795 (0.786–0.803)	0.908 (0.897–0.92)
Patients who survived at least 1 year		
1	1.000	1.000
2	0.963 (0.960–0.967)	0.982 (0.977–0.987)
3	0.923 (0.918–0.928)	0.969 (0.963–0.975)
4	0.888 (0.882–0.895)	0.948 (0.941–0.956)
5	0.847 (0.839–0.856)	0.924 (0.913–0.935)

absolute attendance rates may be underestimated. At a maximum, the attendance rate in Victoria may be 35% (4474 attendees, 12 821 cardiac patients surviving at least 30 days). The relative attendance rates in groups of covariates (eg, by age group) and their statistical difference remain meaningful.[14]

Our observational analysis was subject to confounding due to the non-random assignment of treatment. Thus, the strength of outcome associated with cardiac rehabilitation in our analysis may have been influenced by factors other than cardiac rehabilitation. Nevertheless, the implications of our findings remain strong. Cardiac rehabilitation attendance is underutilised by groups that may benefit most from it: the elderly, women, people with comorbid conditions and those without access to teaching hospitals and private hospitals. Additionally, the reason for the difference in attendance rates after CABG and AMI bears further investigation.

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COMPETING INTERESTS

None identified.

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