Cardiac Rehabilitation in Abu Dhabi: A Retrospective Investigation of Program Delivery, Participants, and Factors Associated with Program Completion Utilizing a Hospital Registry

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Cardiac Rehabilitation in Abu Dhabi: A Retrospective Investigation of Program Delivery, Participants, and Factors Associated with Program Completion Utilizing a Hospital Registry

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Abstract

Objectives: Investigations into the provision of cardiac rehabilitation from the Arabian Gulf countries are rare, despite suffering from an unusually high prevalence of cardiovascular disease. This study reports patient and program characteristics from an exercise-based cardiac rehabilitation program in Abu Dhabi, and factors associated with program completion.

Methods: Data was drawn from the institution's cardiac rehabilitation registry, populated from the electronic medical record of patients enrolled in the hospital-based cardiac rehabilitation program, from 2015 to 2022. The program was administered by physical therapist and nurse specialists and guided by individualized exercise parameters. Completion of the program was defined as attendance of ten or more sessions. Relationships between program completion and demographic characteristics, quality of life, depression, and physical function were explored statistically.

Results: A total of 1774 patients attended at least one session, with a total of 15,563 sessions. The number of patients and sessions trended upward since program inception. The most common referral diagnoses of participants who completed the program were coronary artery bypass grafting, valve surgery, and percutaneous coronary intervention. Among all 1774 attendees, median age was 56, comprised of 61.6% male, and 77.1% residents of Abu Dhabi, and 73.5% Emirati nationals. 527 (29.7%) patients completed the program, and this group was significantly lower in BMI (29.4 vs 30.4 kg/m^2), had lower prevalence of moderate to severe depression (9.0 vs 13.0%), were more often Abu Dhabi residents or Emirati nationals (88.2 vs 72.2%, and 76.9 and 72.0%, respectively), and more likely to have completed the 6-min walk test at the first visit (80.5 vs 72.5%). There were no differences between those who did and did not complete cardiac rehabilitation with respect to age, gender, quality of life, or first 6-min walk test distance.

Conclusions: There is a growing demand for cardiac rehabilitation in Abu Dhabi, particularly among Emirati nationals and residents of Abu Dhabi. Potential risk factors for non-completion such as higher body-mass index, depression, lower physical function, non-residence in Abu Dhabi, and non-Emirati nationality warrant further exploration.

Keywords: Cardiac rehabilitation, Middle East and North Africa, Exercise, Cardiovascular disease

1. Introduction

Cardiovascular disease (CVD) is the leading cause of death worldwide and the leading cause of disability in the MENA region [1]. The UAE has one of the highest global age-standardized death rates from CVD [2,3]. People with CVD in this region tend to be younger and have more severe complications than global counterparts [3]. A high prevalence of risk factors such as obesity, hypertension, dyslipidemia, unhealthy eating habits, and sedentary lifestyles among the countries of the GCC likely contributes to the average onset of acute coronary syndrome being ten years less than in Europe [4,5]. While countries in this region have managed to improve population health in recent decades, this

has largely been accomplished through a curative approach to diseases, leaving the development of primary and preventive services trailing behind [6].

The provision of exercise-based CR is recommended in national guidelines of western countries [7–9], and supported by A1 level evidence in Cochrane reviews for coronary heart disease [10] and heart failure [11]. CR is most often described as a medically supervised, structured, comprehensive, and multi-disciplinary program taking place in outpatient clinics, with evidence for being a cost-effective intervention [7,10]. Participation is recommended for many conditions, including atherosclerotic disease, heart failure, peripheral arterial disease, and after acute coronary syndrome events, coronary artery bypass grafting, revascularization procedures, and valve surgeries. The positive effects of CR are consistent across risk categories, intervention type, exercise dose, and setting. Benefits include reduced rates of cardiovascular hospitalizations, reduced occurrence of myocardial infarction and stroke, improved cardiovascular risk profiles, reductions in anxiety and depression, improved exercise capacity and quality of life, and reduced cardiovascular and all-cause mortality. Furthermore, interventions including strength training may impact on frailty and its relationships with cardiovascular disease [12].

CR programs in countries of the GCC are rare. A survey of the MENA region published in 2015 [1] identified four programs in the GCC (1 each in Qatar and Bahrain, 2 in UAE). Across eight programs in the MENA region, authors found inconsistent application of patient centered assessments and program outcomes, and low rates of program attendance and completion rates. More recent publications have provided conflicting accounts of the existence of CR programs in KSA [13,14].

Original investigations of CR in the GCC are also rare, consisting of three studies of small size from KSA (total of 137 patients). In a study published in 2018 [15], 15 patients who underwent coronary artery bypass grafting had improved measures of hemodynamic responses and functional exercise capacity after completing a hospital-based outpatient CR program for 8 weeks. Randomized trials published in 2012 [16] and 2022 [13] found superior outcomes from home-based and outpatient-based CR models compared to usual care (no rehabilitation) among patients who underwent coronary artery bypass grafting — delivering similar improvements in exercise capacity, anxiety and depression, and quality of life measures. These publications represent an important start to CR research, however, there remains a critical need to describe the current state of CR in the GCC, and advance patient access to this

Abbreviations	
BMI	body mass index
CR	cardiac rehabilitation
CVD	cardiovascular disease
EQ5D	EQ-5D-3L
EQ5D-IS	EQ5D index score
GCC	Gulf Cooperation Council
KSA	Kingdom of Saudi Arabia
MENA	Middle East and North Africa
PHQ-9	Patient Health Questionnaire
UAE	United Arab Emirates
VAS	EQ5D visual analog score
6MWT	Six Minute Walk Test

service. The purpose of this study is to describe program delivery, participants, and factors associated with program completion from a CR program in Abu Dhabi.

2. Materials and methods

Data for this investigation was drawn from the Outpatient Physical Therapy Cardiac Rehabilitation Patient Registry, which extracts data pertaining to program metrics and participant characteristics from electronic medical records. The registry includes data from all patient visits to CR. For this study, data from 2015 to 2022 was used, with no exclusions on patient age or other characteristics. If a person participated in multiple episodes of care in CR, each was counted as a separate and unique case.

Variables with normal distribution were summarized with means and standard deviations. Variables with non-normal distribution were summarized with medians and interquartile ranges. Variables hypothesized to influence completion of CR were identified a priori and evaluated for statistical significance at the 0.05 level. Variables included the following dichotomous variables — gender, nationality (Emirati or non-Emirati), residency in Abu Dhabi, presence of moderate-severe to severe depression, and completion of 6-min walk test (6MWT) on first visit; and continuous variables — age, body mass index (BMI), EQ-5D-3L (EQ5D), and Patient Health Questionnaire (PHQ-9). A one-tailed z-test was employed for dichotomous variables, and an unpaired t-test was employed for continuous variables. Mood's median test was utilized to analyze variables with non-normal distributions.

2.1. Program description

The outpatient hospital-based CR program opened in 2015 as an integral component of the

heart and vascular institute that expanded the capacity of the local health system to deliver specialized care not previously available within the UAE. From its inception, the CR program was an exercise-based program led by physical therapists, with on-site physician support.

The program delivers sessions for men and women on separate days of the week out of consideration for local cultural values. Participants are referred by physicians from outpatient clinic visits or upon discharge from hospital admissions. The first CR visit includes assessment by a physical therapist and cardiac rehabilitation nurse specialist. Participants are stratified by risk profile, and physiological assessments are used to design an individualized exercise program primarily relying on heart rate parameters and rating of perceived exertion to prescribe a moderate to somewhat hard intensity of exercise. Each evaluation session is intended to include administering the 6MWT, EQ5D, and PHQ-9.

Follow-up treatment sessions are one hour in length and most consist of exercise training — primarily aerobic training (overground walking, treadmill, and stationary cycling) complemented by flexibility and strength training. Exercise intensity is monitored and progressed by heart rate targets and rating of perceived exertion. Portable telemetry devices are utilized for patient monitoring in the first phase of sessions and as needed thereafter. Educational sessions are incorporated which are provided by physical therapists, dietitians, and pharmacists for topics which include instruction on modifiable risk factors, exercise and activity, nutrition, and pharmacologic management. Standards for the frequency with which outcome measures should be re-administered were not well defined at the time of program inception; however, more recently, the decision to re-administer these instruments at every tenth visit has been promoted.

While the number of sessions is individually prescribed, for the purposes of this investigation, the attendance of ten or more sessions is considered as program completion. Although ten is a smaller number of sessions than proposed by most guidelines, participants in our program face barriers that limit attendance. Due to these access barriers, our CR program aims to provide participants with ten rehabilitation sessions at minimum, and more as needed and according to feasibility or insurance converage.

2.2. Instruments

The 6MWT [17] measures the distance that a patient is able to walk in six minutes. It is a self-paced assessment of submaximal functional capacity. Details of the standardized test protocol are provided by the American Thoracic Society [17]. The strongest indication for the 6MWT is to measure response to interventions in patients with moderate to severe heart or lung disease, or for use as a one-time measure of functional status. Distance is shown to be a predictor of morbidity and mortality. Results of the 6MWT can be reported as an absolute value or as a percentage of predicted distance using reference equations from healthy adults [18]. The 6MWT is feasible, safe, and successfully administered in Arabic speaking populations [19—21]. The test is commonly applied in clinical practice and research across cardiovascular disease groups including heart failure, post-myocardial infarction, and post-surgery [22].

EQ5D [23] is a group of instruments that was developed to describe quality of life across a wide range of diseases, and as a simple descriptive profile for health status. It has been used widely in clinical trials for more than 25 years. The instrument is valid, reliable, and responsive in numerous conditions and populations. This study employed the most widely used version, the EQ-5D-3L, which generates an "index score" (IS) and a visual analog scale score (VAS). EQ5D-IS is a summary of a respondent's current health status, incorporating the domains of mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. A higher index score represents a greater quality of life, and an unaffected quality of life is represented by a score of one. The VAS asks respondents to rate their current overall health from 0 to 100; a higher number represents greater quality of life. The Arabic translation from instrument developers was utilized according to participant preference [24].

Health professionals are advised to screen for depression among patients with cardiovascular disease [25], and in this program was done by administering the PHQ-9 [26]. In this 9-item questionnaire the respondent indicates how often he or she was bothered by symptoms related to depression over the previous two weeks. The instrument has proven validity and reliability. Although depression is not diagnosed based on PHQ-9 alone, the instrument has a diagnostic advantage compared with other screening tools [27,28]. Results can be used to plan and monitor treatment. In this study, we dichotomized CR participants into two groups: a group demonstrating moderately-severe to severe depression (scores of 15—27), and a group with none to moderate (scores of 0—15). The Arabic translation from instrument developers was utilized according to participant preference [29].

Operating room cases (coronary artery bypass grafting and valve surgeries) from our institution were examined to understand characteristics of surgical patients referred to CR. Data on the number of surgeries, and patient age, gender, nationality, residence, and insurance status was retrieved.

This patient registry was created and used with approval by the Cleveland Clinic Abu Dhabi Research Ethics Committee (study number A-2022-054) and conforms to standards applicable to the country of origin.

3. Results

A total of 1774 patients attended at least one session of CR, with a total of 15,563 sessions. Figure 1 illustrates the number of sessions completed in each year, and the composition of the 15,563 completed sessions. Each year, between 4.0% and 12.5% of sessions were evaluations and re-evaluations. Educational sessions accounted for between 0.0% and 7.0% of sessions. The remainder of visits (81.4%—93.9%) were exercise-based follow-up sessions. Both the number of new patients enrolled and completed sessions per year generally increased, with the closure of clinics due to COVID-19 accounting for lower numbers in 2020. Figure 2 illustrates the proportion of participants who completed one session, two to nine sessions, and ten or more sessions. 527 of 1774 patients (29.7%) completed ten or more CR sessions, with a trend toward lower completion rates as years progressed. The proportion of patients who attended the evaluation but did not attend any follow-up sessions trended upward annually.

Recognizing that not all patients who underwent cardiac surgery in our institution went on to participate in CR, we analyzed data pertaining to all operating room cases (referred to cardiac rehabilitation) for comparison with the subset of those who completed CR. Operating room data indicated that patients who underwent coronary artery bypass grafting or valve surgery (the two largest groups of participants who completed CR) had a median age of 56 years, the majority were male and residents of Abu Dhabi, and a minority were Emirati nationals. Those completing the CR program had a median age of 59, and were majority male, residence of Abu Dhabi, and Emirati nationals. See Table 1 for details. Figure 3 summarizes insurance status of all operating room cases, showing that from 2015 to 2017 most patients were Emirati nationals covered by Thiqa — the government insurance program provided to nationals. After 2017, these patients were a minority, reaching a low of 20% in 2022. Over the course of years, a steady was seen in the proportion of un-insured or under-insured patients (whose hospital stay was paid for by government mandate) and expatriates (holding the Daman private insurance coverage). Other private commercial insurances also grew to a larger minority.

Referral diagnoses for participants were available only for those patients who completed the CR program, and are listed in Table 2. The most common referral diagnoses were post-coronary artery bypass graft surgery, valve surgery, and percutaneous coronary intervention — together accounting for more than 64% of all participants.
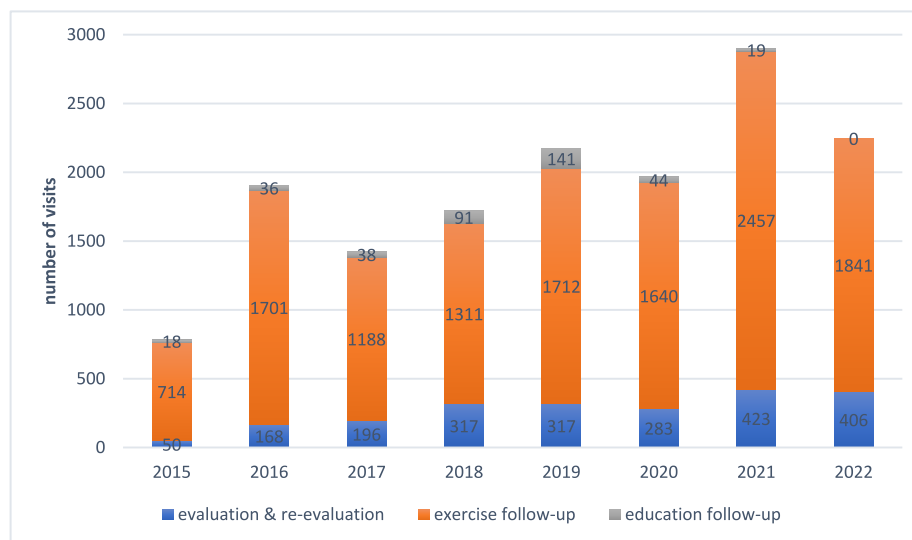

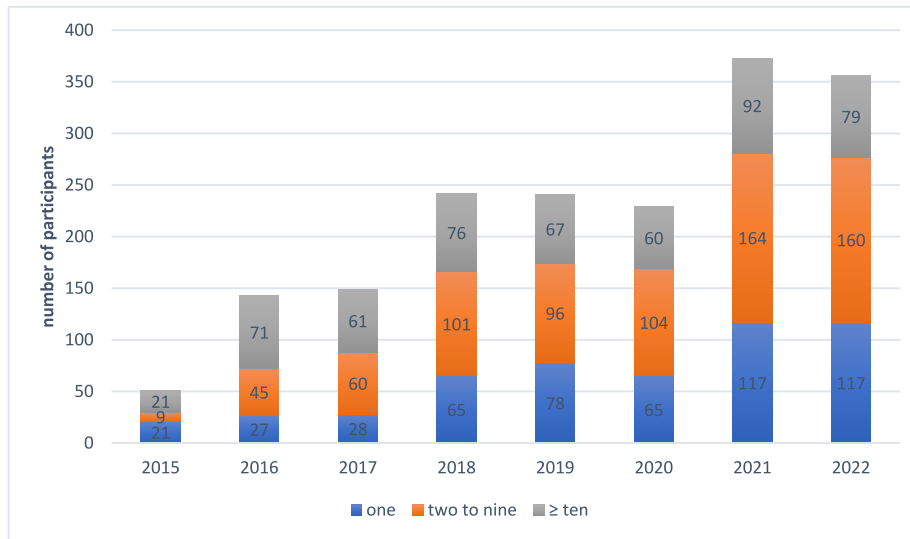Fig. 1. Composition of cardiac rehabilitation sessions.

Fig. 2. Number of sessions attended by each participant.

The full population of attendees (1,774) was divided into two cohorts: those who completed the program (attended ten or more sessions) and those who did not complete the program (attended less than ten sessions). As indicated in Table 3, the groups did not differ in age, gender, distance walked on first 6MWT, or quality of life. However, statistically significant associations were found between program completion and Emirati nationality, residency in Abu Dhabi, lower BMI, completion of 6MWT on program entry, and lower depression and rates of moderate-severe to severe depression.

4. Discussion

Our data demonstrates a growth in the number of patients and sessions in our institution's CR program, suggesting a rising demand or awareness within the local healthcare system. A trend toward a smaller proportion of patients attending follow-up sessions, and smaller portion of patients completing ten or more sessions, is evident. The cause of this cannot be known from our data. We hypothesize that a diversification in the composition of insurance status among surgical patients (with smaller proportion of Emirati patients with Thiqa coverage), and the growing number and proportion of surgical patients whose procedures and hospital admissions were provided under government mandate, has resulted in poorer coverage for CR.

The vast majority of sessions provided were exercise-based sessions. There was a trend for fewer formal education sessions which would typically involve a multidisciplinary team of physical therapists, dietitians, nurses, and pharmacologists. This was likely a result of lack of insurance reimbursement for CR services provided by non-physical therapists. To mitigate the loss of educational content, patient-tailored education was delivered informally to participants through therapists or nurses during regular exercise-based follow-up sessions. However, this was not measured, and the effectiveness of this strategy is unknown.

Our data indicates a low CR referral and completion rate, and a significant relationship between program completion and BMI, nationality, residency in Abu Dhabi, physical function, and depression. Our findings align with those of

Table 1. Demographics of CABG and valve OR cases and participants completing CR.

	CABG and valve cases in OR (n = 2056)	Participants completing CR, all diagnoses (n = 262)
age (years)[a]	56 (IQR 47−64)	59 (IQR 48−68)
male (%)[a]	1620 (78.8)	170 (64.9)
Emirati national (%)[a]	635 (30.9)	208 (79.4)
resident of Abu Dhabi (%)[a]	1564 (76.1)	232 (88.5)

CABG = coronary artery bypass graft; OR = operating room; CR − cardiac rehabilitation.
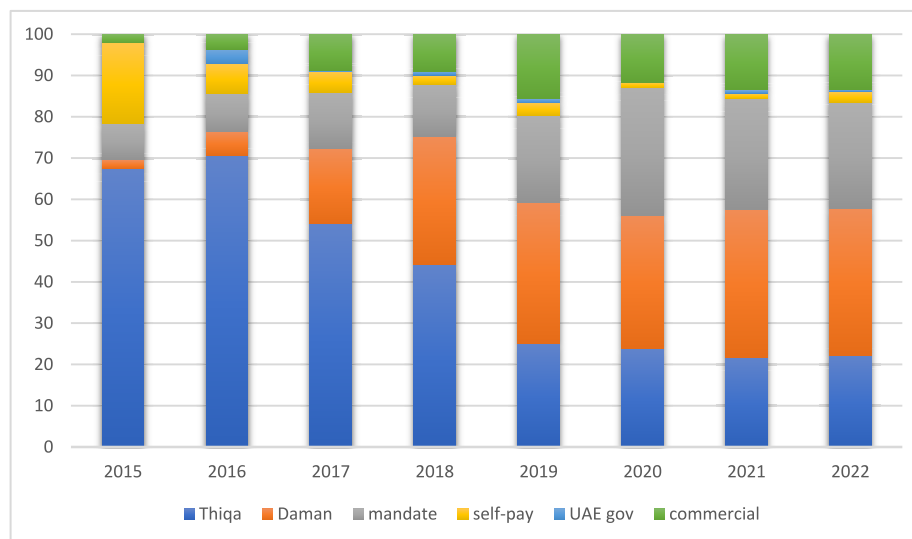[a] Indicates variable with zero participants missing data.

Fig. 3. Insurance status of cardiac surgery cases.

previous work that reports underutilization of CR across surgical, non-surgical, and heart disease populations in Europe [30,31], America [32—37], and Australia and New Zealand [38]. Geographic distance from program centers and depression are previously reported barriers [30,34,39]. Participants in our program completed fewer sessions than published recommendations and reports [35,36]. This likely reflects unique insurance and geographic barriers which may be less prevalent in western countries with more widespread programs and universal health care provision. Despite the unique

Table 2. Referral diagnoses of participants completing program (n = 262).

Primary diagnosis for referral to CR (%)[a]	
- coronary artery bypass graft	60 (22.9)
- valve surgery	55 (21.0)
- percutaneous coronary intervention	53 (20.2)
- dysrhythmia	23 (8.8)
- heart failure	20 (7.6)
- coronary artery disease	14 (5.3)
- deconditioning	6 (2.3)
- other cardiac surgery	5 (1.9)
- angina	4 (1.5)
- myocardial infarction	4 (1.5)
- pacemaker	4 (1.5)
- SOB	3 (1.1)
- Other: PAD, PVD, POTS, aortic dissection, HTN, LVAD, CM	each <1.0

CM = cardiomyopathy; HTN = hypertension; LVAD = left ventricular assist device; PAD = peripheral artery disease; POTS = postural orthostatic tachycardia syndrome; PVD = peripheral venous disease.
[a] Indicates variable with zero participants missing data.

Table 3. Factors associated with program completion.

	All Participants (n = 1774)	<10 Sessions Completed (n = 1247)	≥10 Sessions Completed (n = 527)	p-value
age (years)	56.0 (15.2)	55.6 (15.3)	56.9 (15.1)	0.0955
#md (%)	0 (0)	0 (0)	0 (0)	–
male (%)	61.6	60.8	63.2	0.33706
#md (%)	0 (0)	0 (0)	0 (0)	–
BMI (kg/m^2)	30.1 (7.0)	30.4 (7.3)	29.4 (6.0)	**0.0028**
#md (%)	57 (3.2)	43 (3.4)	14 (2.6)	-
Emirati national (%)	73.5	72.0	76.9	**0.034**
#md (%)	0 (0)	0 (0)	0 (0)	-
resident of Abu Dhabi (%)	77.1	72.2	88.2	**<0.00001**
#md (%)	1 (0.0)	1 (0.0)	0 (0)	–
completion of 6MWT on 1st visit (%)	74.9	72.5	80.5	**0.00044**
#md (%)	0 (0)	0 (0)	0 (0)	-
6MWT distance (meters)	324.0 (115.4)	323.3 (119.6)	325.5 (106.0)	0.7432
#md (%)	446 (25.1)	343 (27.5)	103 (19.5)	–
EQ5D-IS (median)	0.800 (IQR 0.689–0.827)	0.800 (IQR 0.678–0.827)	0.810 (IQR 0.708–0.833)	0.071
#md (%)	127 (7.2)	89 (7.1)	38 (7.2)	–
EQ5D VAS	70.0 (IQR 60.0–85.0)	70.0 (IQR 55.0–85.0)	70.0 (IQR 60.0–90.0)	0.39
#md (%)	332 (18.7)	234 (18.7)	98 (18.6)	–
PHQ-9 score (median)	6.0 (IQR 3.0–11.0)	7.0 (IQR 3.0–11.0)	5.5 (IQR 2.0–10.0)	**0.0071**
#md (%)	122 (6.9)	85 (6.8)	37 (7.0)	-
mod-sev to sev depression (%)	12.4	13.0	9.0	**0.0198**
#md (%)	0 (0)	0 (0)	0 (0)	-

#md = number of participants with missing data (%).

context, our shorter program duration should stimulate thought on how to increase the number of sessions delivered, as prior evidence demonstrated that higher dose of exercise in CR is associated with better exercise capacity outcomes [11,40].

4.1. Limitations

Our program may differ from other CR programs in the region, so findings may not be generalizable. While we define program completion as attendance of ten or more sessions, the ideal and prescribed number of sessions in clinical practice depends on individual conditions, goals, and progress. However, due to practical constraints of the clinical context, we assigned a minimum of ten visits for the purpose of aggregating program outcomes.

5. Conclusion

This is the first published description of a cardiac rehabilitation program in the Gulf countries, and to our knowledge also the first from the MENA region. The rising regional burden of cardiovascular disease calls for an examination of the current healthcare infrastructure and primary and secondary prevention strategies, so that cost-effective programs can be implemented. Health care models, payment schemes, demographics, environmental factors, and attitudes and beliefs regarding health in this region may differ from the contexts from which prior cardiac rehabilitation research has been produced. Therefore, rigorous research must be executed in this region in order to examine current management.

Data from this cardiac rehabilitation registry offers the first insights into program delivery, participant characteristics, and the proposal of factors associated with program completion. Our analysis shows a statistically significant relationship between program completion and body mass index, nationality, geographic residence, physical function, and depression, which ought to encourage further investigation, and, if warranted, to design interventions that reduce these barriers.

Author contribution

Conception and design of Study: AHT, Literature review: AHT, Acquisition of data: AHT, Analysis and interpretation of data: AHT, Research investigation and analysis: AHT, Data collection: AHT, Drafting of manuscript: AHT, Revising and editing the manuscript critically for important intellectual contents: AHT, Data preparation and presentation: AHT, Research coordination and management: AHT.

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Conflicts of interest

None declared.

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