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ORIGINAL RESEARCH

Availability and characteristics of cardiac rehabilitation programs in one Brazilian state: a cross-sectional study

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Abstract
Background: Cardiac rehabilitation (CR) is a recommended model of care for cardiovascular diseases; however, is not widely available and is underutilized, especially in low- and middle-income countries.
Objectives: To identify the CR programs available in one Brazilian state (Minas Gerais; MG) and describe their characteristics by funding type.
Methods: In this multi-center descriptive study, CR programs were identified in four MG regions and 41 CR coordinators were sent a survey to report the characteristics of their programs, including CR components described in guidelines and barriers to patients' participation. Descriptive and comparative analysis between public and private programs were carried out.
Results: Forty-one CR programs were identified, only 21.9% public. Nineteen completed the survey. The majority of CR programs offered initial assessment and physical training. Components of comprehensive CR programs that were rarely offered included treatment of tobacco dependence, psychological support and lipid control. Physical therapists were present in all CR programs. The six-minute walk test was used in most programs to assess functional capacity. Programs were located intra-hospital only in public hospitals. Phase 2 (initial outpatient) and phase 4 (maintenance) were offered significantly more in private programs when compared to public ones. The main barrier for CR participation was the lack of referral.

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Conclusions: The availability of CR programs in MG state is low, especially public programs. Most programs do not offer all core components of CR.

Introduction

Cardiovascular diseases (CVDs) are among the leading cause of morbidity and mortality worldwide, with 80% of deaths occurring in low- and middle-income countries, such as Brazil.[1] The CVD mortality rate in Brazil in 2013 was 168.9 per 100,000 inhabitants.[2] There have been significant advances in acute treatment for patients with CVDs. Thus, many individuals are still living in poor health due to the morbidity of this chronic condition, which requires comprehensive management.

Cardiac rehabilitation (CR) is the recommended model of care for these patients.[3–8] It consists of internationally-agreed core components (including physical training), delivered by a multidisciplinary team.[3] CR participation has numerous benefits[9] – including reductions in hospital readmissions rates up to 25%[1,10] and in long-term cardiovascular mortality.[10]

Recently, the Brazilian Ministry of Health issued the Ordinance no. 483, which redefines the healthcare network for people with chronic diseases (including CVD) treated by the Brazilian Unified Health System and establishes guidelines for the participants care. Rehabilitation was included in these recommendations for all chronic diseases.[11] However, it is known that most Brazilians do not have access to CR programs and resources for prevention of cardiovascular diseases are insufficient across the country.[12,13] Indeed, data on the availability and characteristics of CR programs in Brazil are scarce[14] and there is no national or state registry.[15] It is important to show the reality of CR in Brazil, which will contribute to CR advocacy.

Therefore, the primary objective of this study was to identify CR programs available in the Brazilian State of Minas Gerais (MG) and describe their characteristics. The secondary objective was to compare these CR programs by funding source (public vs. private). The state of MG was chosen because it is geographically extensive and has socioeconomic variation consistent with Brazil more broadly. We hypothesized that few CR programs would be identified in MG, and most of these services would be exercise-based. In addition, we also hypothesized that there would be significant differences between public and private programs regarding prescription, intensity and monitoring of exercise in the different phases of the CR.

Methods

Study design and procedure

This is multi-center, cross-sectional survey study. It was registered in the Brazilian Ethics Platform of Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil (CAAE: 37156614.8.1001.5149) and approved by the Ethic Committees of all participating centers. The availability of CR programs was assessed through contact with clinical directors of hospitals and coordinators of state and municipal Cardiology departments, as well as through electronic searches in the Google® platform using keywords such as CR and the name of each MG municipality with a population of more than 45,000 inhabitants. CR programs coordinators were recruited by e-mail between February 2015 and November 2016. All participants signed an electronic or consent form. Participants chose between an electronic survey (via Survey Monkey®) or to complete printed copies. Ten days after receiving the survey, non-responding participants were contacted by telephone and via e-mail to request their participation. If they failed to complete the survey after 5 attempts they were excluded. All participants received an identification number to ensure their anonymity.

Setting

In order to facilitate data collection, the state of MG was divided into 4 regions based on the Health Regionalization Master Plan of the State Health Department, as follows: (1) Central (population: 5,056,252; human development index – an index that include health, education and income in its calculation)[16]: 0.810); (2) South and Southeast (population: 1,262,176; human development index: 0.778); (3) Northwestern and MG Triangle (population: 1,144,807; human development index: 0.772); and, (4) North and Northeast (population: 587.885; human development index: 0.716). Data collection was carried out from February 2015 to September 2017. A local researcher coordinated the data collection following the same protocol in each region.

Sample

All CR program coordinators identified were invited to participate in the research, regardless of whether the program was comprehensive (including all core CR components) or based only in physical exercise (exercise-based CR). CR programs are divided into four phases: phase 1 (in-hospital), phases 2 (initial outpatient) and 3 (outpatient) and phase 4 (maintenance).[17] There were no exclusion criteria.

Measures

The characteristics of CR programs was evaluated by a Portuguese version of the ''Current Status of Cardiac Rehabilitation Programs in Latin America Survey'' developed by Cortes-Bergoderi[14] and cross-culturally adapted into the

Brazilian reality. The content of the survey assessed characteristics of CR as outlined below, and was discussed with experts.[14] The content validity and face validity were established in the previous study.[14] This survey contained sections including: (1) general information; (2) program features offered (e.g., number of sessions and program types); (3) accepted patient indications; (4) risk factor management; (5) funding sources; (6) characteristics of healthcare professionals; and (7) barriers to delivery. In addition, the survey assessed delivery of core components[4] such as: initial assessment, nutritional counseling, risk factor management (control of lipid profile, blood pressure, glucose and body composition as well as smoking cessation), psychosocial support, as well as physical activity counseling and training. The survey consisted of 53 multiple choice, yes/no, and open-ended questions.

Statistical analyses

Statistical analyses were conducted using the software IBM Statistical Package for the Social Sciences version 20. Descriptive statistics were computed to describe the availability and characteristics of CR programs in MG. The characteristics were then compared between public and private healthcare systems, using chi-square tests (Pearson or Cramer's V). Values of $p < 0.05$ were considered statistically significant. Responses to open-ended questions were coded, and reported as frequencies (%).

Results

Availability of CR programs in MG

The state of MG has 853 cities, of which 77 have a population greater than 45,000. Of these, only 18 cities have CR programs. A total of 41 CR programs were identified, being 9 (22%) public and 32 (78.0%) private. With regards to location, 19 (15 private; 78.9%) are in the central region, 18 (15 private; 83.3%) in the south and southeast, 4 (2 private; 50.0%) in the northwestern and MG triangle, and none in the north and northeast. This study state has a total population of 8,051,120 inhabitants; therefore, the density of CR programs per inhabitants is 1/196,369.

Sample

The sample consisted of 19 respondent programs (total response rate 46.3% total; 9 or 47.4% public and 10 or 52.6% private). With regard to region, nine (47.4%) were from the central region, six (31.6%) from the south and southeast region and four (21.0%) from the northwest region and the MG triangle. The survey was completed by all public programs coordinators ($n = 9$), but by only 10 of 32 private ones (response rate = 31.2%).

Descriptive data

Characteristics of CR programs in MG

CR programs served a median of 35 (minimum 4, maximum 350) participants per year, with a median of 143 sessions per month (minimum 12, maximum; sessions offered to each patient per week are shown in Table 1). Only seven (36.8%) programs were located in an academic center. Seventeen (89.5%) CR programs had an electronic patient database, and ten (52.6%) had a research department associated with the program.

With regard to funding source, three (15.8%) were paid by participants (private payment), seven (36.8%) by the Brazilian Health System, six (31.6%) by health plans, two (10.5%) by private institutions of higher education to which they belong and one (5%) by multiple sources (i.e., patients and Brazilian Health System). In regards to setting, four (21.0%) CR programs, all public, were located in-hospital. Only three (15.8%) CR programs had the in-hospital phase (2 public and 1 private) and phases 2 and 4 were usually offered by private programs ($p = .047$ and $p = .011$ compared to public, respectively; Table 1).

Table 2 displays the characteristics of these CR programs by type of funding (public or private), including healthcare providers in the CR team. As shown, most programs accepted patient indications for which there are guideline recommendations for CR.[5–8] Only half accepted high-risk patients. Few programs assessed lipids and metabolic syndrome (although as per Table 3, other risk factors were assessed). Only one program (5.3%) assessed novel cardiovascular risk markers such as homocysteine and lipoprotein, and two (10.5%) assessed C-reactive protein (data not shown).

CR components offered

Six (75.0%) programs offered primary and secondary CVD prevention services. Table 3 presents the components offered by type of funding. Initial assessment and exercise prescription were offered in all programs, physical activity counseling in 17 (89.5%), management of risk factors in eleven (57.9%), psychological support in five (26.3%) and tobacco dependence control in two (10.5%). Consideration of family members and post-program follow-up consultations were offered mainly by private programs, but there were no significant difference when comparing by funding source.

CR phases and exercise training characteristics

As shown in Table 1, phase 2 and 4 programs were more often private than publically-funded. Exercise intensity prescription and monitoring were performed using most-commonly the 10-point Borg rating scale of perceived exertion.[18] Exercise sessions were most-commonly supervised by a physical therapist, with patients exercising on a treadmill or stationary bike.

Patients' barriers identified by CR coordinators

Regarding barriers to CR participation, the lack of medical referral was the most relevant ($n = 6$ public and 5 private, 57.9% of the total), followed by lack of physical space to include a CR center ($n = 2$ public and 1 private, 15.8% of the total) and lack of funding ($n = 1$ private, 5.2% of the total).

Table 1 Characteristics of physical training performed in Cardiac Rehabilitation (CR) Programs in Minas Gerais by CR phase and type of funding (total $n = 9$ public and 10 private).

	Phase 2		Phase 3		Phase 4	
	Public	Private	Public	Private	Public	Private
Number of programs/phase	6 (66.7%)	10 (100.0%)*	7 (77.8%)	8 (80.0%)	3 (33.3%)	9 (90.0%)*
Exercise prescription[a]						
Borg scale	6 (100.0%)	7 (70.0%)	7 (100.0%)	5 (62.5%)	3 (100.0%)	5 (55.5%)
Age-predicted rate	2 (33.3%)	3 (30.0%)	3 (42.8%)	2 (25.0%)	2 (66.6%)	2 (22.2%)
Direct VO_2 max	0	3 (30.0%)	0	3 (37.5%)	0	3 (33.3%)
Indirect VO_2 max	4 (66.6%)	1 (10.0%)	4 (57.1%)	0	1 (33.3%)	0
Maximum heart rate	5 (83.3%)	7 (70.0%)	5 (71.4%)	7 (87.5%)	3 (100.0%)	7 (77.7%)
Reserve heart rate	3 (50.0%)	3 (30.0%)	5 (71.4%)	2 (25.0%)	0	1 (11.1%)
MET	2 (33.3%)	1 (10.0%)	1 (14.2%)	1 (12.5%)	1 (33.3%)	0
Other	0	1 (10.0%)	0	1 (12.5%)	0	1 (11.1%)
Exercise monitoring[b]						
Borg scale	6 (100.0%)	7 (70.0%)	7 (100.0%)	5 (62.5%)	3 (100.0%)	6 (66.6%)
Heart rate	6 (100.0%)	10 (100.0%)	7 (100.0%)	8 (100.0%)	2 (66.6%)	9 (100.0%)*
Supervisor						
Physical therapist	6 (100.0%)	9 (90.0%)	7 (100.0%)	7 (87.5%)	2 (66.6%)	8 (88.8%)*
Physician	0	1 (10.0%)	0	0	0	0
Nurse	0	1 (10.0%)	0	0	0	0
Physical trainer	0	1 (10.0%)	0	1 (12.5%)	0	1 (11.1%)
Session/week						
2	2 (33.3%)	3 (30.0%)	–	–	–	–
≥ 3	4 (66.6%)	7 (70.0%)	–	–	–	–
Aerobic exercise						
Treadmill	6 (100.0%)	9 (90.0%)	7 (100.0%)	7 (87.5%)	–	–
Stationary bike	6 (100.0%)	8 (80.0%)	7 (100.0%)	7 (87.5%)	–	–
Walking	5 (83.3%)	3 (30.0%)	6 (85.7%)	4 (50.0%)	–	–
Other	1 (16.6%)	0	1 (14.2%)	0	–	–
Resistance exercise						
Weights or dumbbells	6 (100.0%)	8 (80.0%)	7 (100.0%)	8 (100.0%)	–	–
Elastic bands	5 (83.3%)	10 (100.0%)	7 (100.0%)	8 (100.0%)	–	–
Equipment	3 (50.0%)	4 (40.0%)	3 (42.8%)	4 (50.0%)	–	–
Other	0	3 (30.0%)	0	3 (37.5%)	–	–

VO_2, oxygen uptake; MET, metabolic equivalent of task; Phase 2 – outpatient individual; Phase 3 – outpatient group; Phase 4 – maintenance. Differences by type of funding – Chi-square test.

* $p < 0.05$.

[a] These numbers refer to the prescription of exercise intensity or how much each patient would be exercising.

[b] These numbers refer to the monitoring of exercise intensity while they are exercising in the CR program.

Discussion

This study, only the 2nd in Brazil,[19] reinforces findings in other countries[14,20] which indicate low availability (41 programs for the entire state), regional variations, low funding, and lack of comprehensiveness in CR programs.[21] Lack of medical referral was the major barrier identified. The predominance of exercise-based CR programs highlights the urgent need to implement comprehensive CR programs, as widely recommended to ensure management of all CVD risk factors.[3,4,22]

Availability

The proportion of programs/inhabitants identified by this study (1 for 196,369 inhabitants) is disconcertingly low, although higher than the one reported by Cortes-Bergoderi[14] for South America more broadly (1 for 2,319,312 inhabitants). However, it is important to note that our study included programs that mainly include exercise training, which would not be classified as a CR program according to guidelines of cardiovascular associations.[4,17] Thus, the true availability of CR is even lower. It is estimated there are high

Table 2 Characteristics of cardiac rehabilitation programs in the State of Minas Gerais by type of funding (public or private) ($n = 19$).

Characteristics/programs	CR program (n)	
	Public ($n = 9$)	Private ($n = 10$)
Personnel available		
Physical therapist	9 (100.0%)	10 (100.0%)
Nutritionist	4 (44.4%)	4 (40.0%)
Cardiologist	3 (33.3%)	3 (30.0%)
Psychologist	2 (22.2%)	3 (30.0%)
Social worker	2 (22.2%)	1 (10.0%)
Nurse	2 (22.2%)	0
Sport medicine physician	1 (11.1%)	1 (10.0%)
Physical trainer	1 (11.1%)	1 (10.0%)
Personnel formally trained in advanced cardiac life support		
All	3 (33.3%)	6 (60.0%)
Some	5 (55.5%)	3 (30.0%)
None	1 (11.1%)	1 (10.0%)
Type of patients		
Postmyocardial infarction	9 (100.0%)	10 (100.0%)
Post-PCI	9 (100.0%)	10 (100.0%)
Postcoronary bypass	9 (100.0%)	9 (90.0%)
With heart failure as the primary diagnosis	9 (100.0%)	9 (100.0%)
With peripheral artery disease	8 (88.9%)	9 (90.0%)
With valvular disease	7 (77.8%)	9 (90.0%)
Postheart transplant	2 (22.2%)	4 (40.0%)
With syncope as the primary diagnosis	2 (22.2%)	3 (30.0%)
Other	2 (22.2%)	2 (20.0%)
Patient risk classifications accepted[a]		
Without cardiovascular risk	0	3 (30.0%)
Low risk	6 (66.7%)	9 (90.0%)
Moderate risk	8 (88.9%)	8 (80.0%)
High risk	5 (55.5%)	4 (40.0%)
Stress tests performed on CR setting		
6-Min walk test	7 (77.8%)	6 (60.0%)
Shuttle walking test	3 (33.3%)	2 (20.0%)
Conventional ergometric test	3 (33.3%)	2 (20.0%)
Cardiopulmonary test	1 (11.1%)	2 (20.0%)
Lipids assessment performed on CR setting		
Yes	1 (11.1%)	2 (20.0%)
No	7 (77.8%)	8 (80.0%)
Sometimes	1 (11.1%)	0
Assessment of metabolic syndrome performed on CR setting		
Yes	0	2 (20.0%)
No	6 (66.7%)	8 (80.0%)
Sometimes	3 (33.3%)	0

CR, cardiac rehabilitation; PCI, percutaneous coronary intervention. No statistically significant differences were found by type of funding using the Chi-square test.

[a] Bennett JA, Riegel B, Bittner V, Nichols J. Validity and reliability of the NYHA classes for measuring research outcomes in participants with cardiac disease. Heart Lung. 2002;31(4):262–70.

under-served patients who may be prematurely dying, being hospitalized, and suffering low quality of life due to lack of CR.

The regional variation in service availability coincides with what is observed in Brazil more broadly.[19] Regions with higher human development index had a greater number of CR programs, while regions with lower human development index (such as North and Northeast) had no CR. A previous study conducted in Brazil showed that availability of CR is limited to major metropolitan centers, and it is rare

Table 3 Components offered in cardiac rehabilitation programs by funding source ($n = 19$).

Components	CR Program Funding Source *n* (% total)	
	Public *n* = 9 (47.4%)	Private *n* = 10 (52.6%)
Initial assessment	9 (100.0%)	10 (100.0%)
Physical training		
Exercise prescription	9 (100.0%)	10 (100.0%)
Counseling for physical activity	8 (88.9%)	9 (90.0%)
Diet		
Food preparation demonstrations	1 (11.1%)	1 (10.0%)
Nutrition counseling	5 (55.6%)	4 (40.0%)
Cardiovascular risk factors		
Assessment of cardiovascular risk factors	7 (77.8%)	8 (80.0%)
Management of cardiovascular risk factors	6 (66.7%)	5 (50.0%)
Tobacco		
Tobacco consumption assessment	2 (22.2%)	2 (20.0%)
Smoking cessation clinic	1 (11.1%)	1 (10.0%)
Mental health		
Psychological support	2 (22.2%)	3 (30.0%)
Depression screening	2 (22.2%)	3 (30.0%)
Family support programs	3 (33.3%)	4 (40.0%)
Follow-up after completion of the program	2 (22.2%)	5 (50.0%)

CR, cardiac rehabilitation; no statistically significant differences were found by type of funding using the Chi-square test.

in the North and Northeast regions.[19] The same reality is observed in relation to the supply of high technological density services like percutaneous coronary intervention and revascularization.[12]

CR capacity must urgently improve; increasing the number of patients served per program as well as increasing the number of programs (especially in regions where it does not exist) should be pursued. The use of new technologies, such as distance monitoring and education programs (telehealth),[23] and CR programs delivered in more simple and affordable way[4,24] can contribute to expand availability, especially in smaller cities.

Program characteristics

The individual physical exercise prescription and monitoring were available in all CR programs as recommended by CR guidelines – including the South American Cardiovascular Prevention and Rehabilitation Guidelines.[17] Most of the CR programs used appropriate methods to monitor exercise intensity[17] like the Borg scale[18] and heart rate monitors. The use of Borg scale is particularly valuable in patients for whom there is difficulty obtaining a reliable or meaningful exercise-related heart rate (e.g. patients with atrial fibrillation). In addition, the literature indicates that the percentage of reserve heart rate should be the gold standard for exercise intensity indirect assessment using heart rate monitors.[25]

Physical therapists were the member of the multidisciplinary team responsible for exercise monitoring in all programs. Similar results were observed in a study with 9 Latin American countries,[14] of which 72% of CR programs have this professional in the healthcare team. With regards to the cardiologist, the presence of this professional in our study was only observed in 31% of the programs, which might explain why not all programs accepted high-risk patients. In the Latin America study[14] the presence of cardiologists was observed in more than 80% of programs. This discrepancy may be related to study methods: in the current study CR programs were identified through searching institutions, and in the South American study[14] through registries and contacts provided by the South American Cardiology Society, in which there is predominance of cardiologists as members.

Important components of CR programs (such as risk factor management and dietary counseling) are rarely offered by CR programs in MG. Despite South American[17] and international guideline recommendations,[3] the majority of programs offered only exercise-based programs. Indeed, strategies for offering all core components in low-resource settings have been proposed, providing a minimal and realistic standard for CR in low and middle income countries.[3] This study reinforces the need of using this model of CR as a way to increase provision of comprehensive CR Brazil.

The absence of other healthcare professionals as part of the CR team, such as nutritionists and psychologists, limits the implementation of comprehensive CR programs.[4,22] For

instance, only 42% of the programs offered management of cardiovascular risk factors. In addition, only two programs had nurses, who play a key role in the educational component of CR programs, which has shown to positively affect the management of risk factors, self-efficacy, and behavior change.[26]

In regards to the characteristics of the physical exercise offered by the CR programs, the majority of programs performed incremental cardiopulmonary exercise test, offered phases 2 and 3 (or outpatient phases), and prescribed and monitored the intensity and type of physical exercise following guidelines.[17] These results are similar to previous studies.[14] The use of the 6-minute walk test was observed in evaluations in most programs, which shows it is widely diffused in Brazil.[27] The reasons for its use include the following: is a simple, easy, safety[28] and low cost test.

Barriers, including funding

This study, consistent with data from low and middle[29] and high-income countries alike,[30] identified lack of medical referral as the main barrier to patients' CR participation. A variety of strategies have been shown to increase CR referral and utilization, including systematized inpatient CR referral and early outpatient education shortly after discharge.[31] The important role of the healthcare team in encouraging CR reinforces the need for greater investments and inclusion of CR-related contents in the educational process,[32,33] not only for participants,[34] but also for inpatient and outpatient health team, including physicians.[26] More studies in low and middle-income countries, including Brazil, are needed to evaluate the impact of these strategies on CR referral and participation.

While the number of public and privately-funded programs in the sample was low and hence comparisons under-powered, tests between public and private programs identified: (1) only public CR programs were located in a hospital setting, and (2) there is a greater predominance of provision of phases 2 and 4 in private programs; and, (3) personnel formally trained in advanced cardiac life support are more frequent in private programs. Previous work has suggested funding source impacts program delivery costs.[35] While the impact of funding source on program quality remains to be established, overall results of this study highlight the need to improve CR coverage across public and private (i.e., health insurance) sources. Several countries have had success advocating for CR reimbursement by both.[21]

Limitations

Caution is warranted when interpreting results. The major limitation is related to selection bias. It is unknown how generalizable the sample from each region is in relation to the average program. Second, the survey failed to assess important CR core components such as patient education, return to work, as well as hypertension and diabetes control specifically. Finally, results are only generalizable to CR programs from one Brazilian state (MG), which may not represent the reality of CR in the whole country. However, findings were consistent with the only other study undertaken in Brazil.[19]

Conclusions

The number of CR programs in MG is much too low. Most programs offer exercise only; advocacy for comprehensive CR is greatly needed. The lack of CR referral is still the main barrier to be overcome, which would be more-readily achieved with greater program availability.

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Conflicts of interest

The authors declare no conflicts of interest.

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