Nilupama Wanigasekara

PROJECT TITLE: Examining the effects of a novel model of cardiac rehabilitation in reducing wait times and increasing adherence to behavior changes promoted by the program

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SUMMARY:

Cardiac rehabilitation (CR) is an effective secondary preventative strategy in patients who have undergone a cardiac event. Even so, some aspects of CR programming remain to be optimized. For example, some patients delay their enrollment in CR based on personal factors or delay their CR enrollment because of program factors. There is also evidence in the literature indicating that group dynamics within the CR peer cohort can contribute to increased adherence to a physically active lifestyle. Therefore, this project was designed to determine if a rolling, continuous entry CR program, where patients can enter CR soon after referral, is more effective than the traditional CR program for modifying outcomes. The student was provided an opportunity to learn how to recruit participants for a prospective, interventional study, to utilize accelerometers to objectively measure physical activity behaviour, assess functional walking capacity and to utilize a variety of validated measures to characterize changes in mood status (depression), anxiety and general health amongst a cohort of CR participants. The student participated in an interdisciplinary, collaborative research team and completed a clinical placement shadowing the health professionals who conduct medical screening and stress testing for all of the CR program clients as well as those allied health professionals who deliver the healthy living and education initiatives within the CR program. The objective for the project was to distinguish a difference between the traditional entry model (TRAD) and the continuous entry model (CONTIN).

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Supervisor's Signature

Introduction:

Cardiac rehabilitation (CR) is an effective secondary preventative strategy designed to decrease the reoccurrence of cardiac events in individuals who have already undergone a cardiac incident and to bring them back to a healthy and more functional lifestyle[1, 2]. The benefits of CR are known to reduce the relative risk of cardiac mortality by 26%[1, 2]. In fact, attendance and adherence to CR may reduce hospitalization (hazard ratio 0.75; 95% CI 0.69-0.81)[3] and reduce mortality by as much as 50%, as compared to people who had not attended CR[3, 4]. These health benefits are generally considered to occur because CR improves patients' aerobic fitness, psychosocial health and wellness and educates participants about cardiovascular risk factor modification[1].

Even though CR programming has been shown to be effective, specific aspects of CR programming remain to be optimized. For example, only a minority (i.e. 15-30%) of patients who are referred make the decision to attend CR[5, 6]. Furthermore, some patients delay their enrollment in CR based on personal factors (such as fear of starting exercise, scheduling issues, and their readiness to change[5]. Alternatively, program factors (such as class size, wait lists or the need to conduct a baseline stress test) may delay the start of CR for some patients[5]. These types of personal and program delays adversely influence CR enrollment. Specifically, it is known that there is a 1% less chance that a patient enrolls in CR for every 1 day delay between the period from CR referral to the actual start of the program[7]. Furthermore, prompt access to CR programming is beneficial for patients because longer wait periods are known to be associated with further deterioration of cardiovascular health[1, 5]. Thus, it is evident that prompt access to CR is a critical aspect of CR program design.

It has been demonstrated that patients tend to increase their physical activity behaviours while enrolled in CR[8]. However, this beneficial effect is not always maintained after the completion of CR. For example, there is evidence indicating that physical activity patterns drop off by as much as 30-60% 6 months after the completion of CR[1, 9, 10]. Based on this information, it is evident that CR programs must identify and employ novel strategies to help patients adopt and maintain a more physically active lifestyle over the long term.

The development of self-efficacy for performing independent exercise may be one strategy that can be utilized to enable patients to improve their adherence to a physically active lifestyle after CR[11]. For example, the literature indicates that self-efficacy can be developed by individuals within a group setting who are experiencing similar events [12] because the peer support group can provide patients with the ability to foster social comparison (i.e.; comparing coping skills), social exchange (i.e.; sharing of feelings and information), and social learning (i.e.; learning about oneself)[13] among the group itself. Based on this information, it is evident that group dynamics within the CR peer cohort can contribute to increased adherence to a physically active lifestyle.

The purpose of this project was to determine if the redesign of CR program enrollment factors and the way CR classes are offered with respect to the peer support group would improve patients' adherence to a more physically active lifestyle after the completion of a 4 month CR program. It was hypothesized that a rolling, continuous entry admissions CR program model would have superior outcomes compared to the standard CR program.

Methods:

Participant recruitment

Sixty nine cardiac patients attending the Winnipeg Regional Health Authority CR program at the Reh-Fit Center (Winnipeg, MB) were recruited to participate in the study from December 2010 through December 2011 (Figure 1). To be included in the study, participants must have experienced a cardiac event, such as episodes of angina, myocardial infarction, coronary artery bypass (CABG) surgery valve replacements, aneurysm, pacer/implantable cardioverter defibrillator (ICD) or arrhythmia. The study excluded patients with a diagnosed exercise-induced arrhythmia or a condition that would have prevented them from safely participating in CR. A convenience sampling approach was used to recruit participants into one of two study groups, namely a traditional (TRAD) or a rolling, continuous entry (CONTIN) CR program model. This convenience sampling approach was used because there is evidence indicating that encouraging individuals to choose a CR program delivery model that best suits their lifestyle improves program adherence and participation[14]. The research study was approved by the University of Manitoba Research Ethics Board, the Winnipeg Regional Health Authority Cardiac Rehab Program Research Review Committee and the St. Boniface General Hospital Research Review Board. Written and informed consent was obtained from all patients prior to enrolment.

Intervention

The TRAD program consisted of the standard 16 week CR program offered at the Reh-Fit Center, where one cohort of CR patients starts the program on the same date and moves through the CR together; whereas, the CONTIN program utilized a rolling, continuous entry admissions CR program model, where patients join a larger CR cohort and are provided the opportunity to interact with more people within the cohort rather than meeting with the same peer group every day. All other aspects of the TRAD and CONTIN programs were similar. For example, both programs consisted of 12 class-based educational sessions plus a 4 month monitored exercise program. The educational sessions consisted of lectures to help patients' increase their awareness surrounding their cardiac event, the beneficial role of exercise and risk-factor reduction, anatomy and physiology of the heart, cardiac test procedures and blood results, medications, and stress management.

Data collection and outcome measures

Data was collected at baseline and then 1, 4 and 6 after the program start date. This schedule enabled us to determine if the CONTIN group maintained or improved their physical activity levels to a greater extent than did the TRAD group during the 4-month CR program and again 6 months after the program start date.

The primary outcome variable for the study was a change in minutes of moderate to vigorous physical activity (MVPA) accumulated in bouts of 10 minutes or longer, as measured objectively using accelerometry. Specifically, Actical accelerometers were used to collect 7 day physical activity patterns (i.e. intensity and duration of physical activity) at each of the four data collection time points. Accelerometers are highly accurate and reliably measure the total duration and intensity of physical activity completed by an individual[15]. Activity intensity was measured as counts per minute, where the cut-points for light activity was less than 750 counts per minute, moderate intensity activity was defined as a range of between 750-3249 counts per minute and vigorous intensity was considered to be greater than 3250 counts per minute[15]. Accelerometers were worn on a belt, positioned on the hip at waist level, and worn during waking hours. Accelerometers have been used for similar research purposes amongst a cohort of cardiac rehabilitation patients previously[15].

Secondary outcome measures included measures of physical fitness, as assessed using the 6 minute walking test (6MWT)[16] and a 5 meter gait speed test (5mGS)[17, 18]. The 6MWT is a submaximal measure of physical fitness where the client is instructed to walk as far as they can in 6 minutes around a 20 meter track at a self-directed pace[16, 19]. Patients were allowed breaks during the test if needed. The 6MWT is an easy and inexpensive test, correlates with peak aerobic fitness in patient populations diagnosed with cardiovascular disease[20] and is thought to reflect activities of daily living[19]. It also has prognostic value in assessing relative-risk of all-cause mortality[16]. The 5mGS was conducted during the 6MWT and was assessed using two different 5 meter spans along the track unknown to the participant. In this test, the participant walked 5 meters at a self-selected pace and the time was taken for the middle 3-meter span to minimize the effect of acceleration and deceleration. The average of 3 trials was used as the 5mGT outcome[18].

Four different surveys were utilized to collect self-reported data. The Cardiac Anxiety Questionnaire (CAQ), which consists of 18 questions, was used to assess changes in heart-focused anxiety[21]. Each of the questions within each category is rated on a 5 point Likert scale in terms of how frequently they occur (0-never, 4-always), where a higher score is indicative of higher anxiety. The CAQ total score provides an indication of the overall heart-focused anxiety that a client may be living with. The CAQ can also be scored using three subscales. Specifically, the fear subscale represents clients' feelings or fear of heart sensations; whereas the avoidance subscale represents the client's avoidance of certain activities that they believe may trigger cardiac symptoms. The heart focused subscale represents their anxiety of cardiac-related stimuli. The Patient Health Questionnaire (PHQ-9), which consists of 9 questions, was used to evaluate the clients' mood status for symptoms of depression over the past 2 weeks. The PHQ-9 has been validated for this purpose and is used as a diagnostic and severity measure of depression[22]. The SF-36 survey was used to assess the client's perception of their quality of life and has been used for this purpose previously[23]. The short-form of the International Physical Activity Questionnaire (IPAQ) was used to collect information about the amount and intensity of physical activity the patient completed in the previous 7-day period[24].

Finally, a chart-review of data collected by the Reh-fit Center for clients specifically enrolled in the study was conducted in order to collect information about cardiac risk factors, ejection fractions, medications and stress test results.

Statistical analyses

Data is presented as mean ± SE or frequency (% of that specific group). The Kolmogorov–Smirnov test was used to assess the normality of data. Baseline demographics were compared using a Student T-test for independent groups. A chi-squared analysis was used to identify differences between categorical groups for cardiac events, risk factors, and medications. A 2 way analysis of variance (ANOVA) with 1 between group comparison and 1 repeated measure (i.e. time) was utilized when appropriate for primary and secondary outcomes. When significant differences were observed using the ANOVA, a Newman-Keuls post hoc was utilized to identify differences between specific means. A Pearson's correlation coefficient was utilized to identify associations between variables. Data was analyzed from the clients who attended 3 or more of the research appointments, which resulted in 30 clients being analyzed from TRAD and 27 being analyzed from CONTIN. Clients that had less than 3 valid data points (i.e.; 1 participant in CONTIN) were not analyzed due to noncompliance.

Results

Participants

Sixty nine clients enrolled in the study. A total of 12 people were lost to follow-up (Figure 1). Demographics at baseline can be found in Table 1. No differences between groups were detected for any baseline parameters, such as age, days from referral to entry or number of CR sessions attended, based on t-test analyses. Likewise, no differences between groups were detected for the frequency of cardiac events prior to entry, risk factors or medication use at baseline based on chi square analyses.

Change in objectively measured physical activity

Physical activity outcomes are shown on Table 2. A 2-way ANOVA identified a main effect of time ($p<0.005$) for the primary outcome variable, which was a change in minutes of MVPA accumulated in bouts of 10 minutes or longer, where baseline < 1 month, and 1 month > 4 and 6 months. Likewise, a change in minutes of total physical activity accumulated in bouts of 10 minutes or longer was higher at 1 month ($p<0.001$) but was not maintained at 4 and 6 months. Similar trends were seen for the 10 minute bouts of total moderate and vigorous physical activity and 10 minute bouts of light activity performed. The total time spent being sedentary in 10 minute bouts or longer at baseline was 3858 ± 268 and 4082 ± 309 minutes in TRAD and CONTIN, respectively. For TRAD group, time spent being sedentary in 10 minute bouts or longer was reduced by 28% at 4 months, as compared to baseline. For the CONTIN group, significantly less sedentary time in 10 minute bouts or longer was observed at 6 months, as compared to baseline (-48%), 1 month (-11%) and 4 months (-2%). Sporadic MVPA, which we have defined as any activity at moderate to vigorous intensity regardless of the length of time it was performed for, peaked at 1 month and remained elevated above baseline levels at 4 and 6 months (main effect of time, $p<0.005$, where baseline < 1 month and 1 month > 4 months and 6 months). A similar main effect of time ($p<0.005$) was identified for the sum of sporadic activity, which we have defined as any activity at any intensity regardless of the length of time it was performed for, where baseline < 1 month and 1 month > 4 months and 6 months. A main effect of group ($p<0.05$) was also identified for the total sum of sporadic activity, where TRAD < CONTIN. However, no further group differences were observed for any other parameter.

Self-reported physical activity

Self-reported IPAQ data are reported on Table 2. Overall, a positive correlation was found between the accelerometer 10 minute bouts MVPA and the amount of MVPA indicated on the IPAQ ($r=0.151$, $p <0.05$). Even so, study participants reported that they were partaking in more IPAQ MVPA than the accelerometer data indicate. For example, the TRAD group reported participating in 161 ± 62 minutes of MVPA at baseline; whereas, CONTIN reported that they participated in 204 ± 74 minutes of MVPA at baseline. Furthermore, a main effect of time ($p<0.001$) was observed for IPAQ MVPA, where baseline < 1 month < 4 months and 6 months.

Walking tests and changes in physical fitness, BMI and waist to hip ratio

Functional walking capacity assessment data are described on Table 2. At baseline, participants walked an average 6MWT distance of 521 ± 19 and 528 ± 23 for the TRAD and CONTIN groups, respectively. Both groups progressively improved their 6MWT distance over time (main effect of time, $p<0.001$, where baseline < 1 month < 4 months and 6 months). Furthermore, a positive correlation ($r= 0.219$, $p < 0.005$) was found between the 6MWT distance and accelerometer MVPA accumulated in 10 minute bouts or longer. The 5mGS was the second test used to assess functional walking capacity and indicated that participants progressively improved their performance over time (main effect, $p<0.001$, where baseline > 1 month, 4 months and 6 months; 1 month > 6 months). As expected, both the 6MWT ($r= 0.199$, $p < 0.01$) and the 5mGT correlated ($r= -0.193$, $p < 0.01$) with accelerometer MVPA accumulated in 10 minute bouts or longer.

Participants underwent physical changes throughout the study. For example, a main effect of time ($p < 0.0001$) was detected for VO_{2peak}, where baseline levels (TRAD 27 ± 1, CONTIN 30 ± 2) were less than levels at 4 months (TRAD 31 ± 2, CONTIN 35 ± 2). A correlation was observed between the change in 6MWT and VO_{2peak}, ($r=0.250$, $p<0.05$). Likewise, an association was observed between the 5mGS and the VO_{2peak}, ($r= -0.280$, $p<0.05$). A correlation was also observed between the number of sessions attended by participants and change in VO_{2peak} ($r=0.334$, $p<0.01$). Waist to hip ratio also improved over time (main effect of time, $p<0.05$), where baseline (TRAD 0.95 ± 0.02, CONTIN 0.96 ± 0.02) were greater than at 4 months (TRAD 0.93 ± 0.02, CONTIN 0.95 ± 0.02).

Survey data

Table 3 summarizes the data collected using the PHQ-9, CAQ and SF-36 survey. At baseline, PHQ-9 total scores were 4 ± 1 and 5 ± 1 for the TRAD and CONTIN, respectively. In general, the PHQ-9 total score improved following the initiation of CR (main effect of time, $P<0.005$, where baseline < 1 month, 4 month and 6 months). PHQ-9 total scores were also utilized to classify patients as having no signs of depression or signs (i.e. minimal mild or moderate) of depression. At baseline, 9 and 11 participants from the TRAD and CONTIN groups reported signs of depression. Over time, the number of patients reporting signs of depression decreased. Notably, a negative correlation was found between PHQ-9 total score and IPAQ MVPA ($r= -0.158$, $p < 0.05$).

Cardiac anxiety parameters were collected using the CAQ. At baseline, CAQ total scores were 25 ± 2 and 26 ± 2 for the TRAD and CONTIN, respectively. Cardiac anxiety progressively decreased over time (main effect, $p<0.01$; baseline > 1 month > 4 month and 6 month). Likewise, CAQ subscale 1: fear was initially highest at baseline and declined over time in both groups (main effect of time, $p<0.01$; baseline > 4 months and 6 months). CAQ Subscale 2: avoidance was also highest at baseline in both groups and gradually declined at 1 month and then further at 4 and 6 months (main effect of time, $p<0.01$). A different response was observed for CAQ subscale 3: heart focused attention. Specifically, a difference between groups ($p<0.05$) was identified at baseline (TRAD, 5 ± 1 and CONTIN, 6 ± 1), respectively. Additionally, heart focused attention increased by 1 point at 1 month and 4 months amongst the TRAD group. Even so, the clinical implication of this 1 point increase is likely to be minimal. Notably, a negative association was identified between CAQ total score and the IPAQ MVPA ($r= -0.135$, $p < 0.05$).

Participant health perceptions were assessed using the SF-36 survey. Unexpectedly, the overall SF-36 general health score did not improve over time and was not influenced by the intervention. However, several subscales of the SF-36 survey were improved by participation in CR. Specifically, SF-36 physical functioning improved over time (main effect; $p <0.001$), where baseline < 1, 4 and 6 months. SF-36 role limitations due to physical health also improved progressively over time (main effect, $p < 0.001$), where baseline <1 month < 4 months and 6 months. Finally, SF-36 role limitations due to emotional problems showed improvement after 1 month of CR and remained elevated for the duration of the study (main effect , $p <0.001$, where baseline < 1, 4 and 6 months). Notably, a positive correlation was identified between SF-36 physical functioning and accelerometer 10 minute bout MVPA ($r= 0.187$, $p< 0.01$) as well as accelerometer sporadic MVPA ($r= 0.147$, $p< 0.05$).

Discussion

This project tested the hypothesis that a rolling, continuous entry admissions CR program model (CONTIN) would have superior outcomes compared to the standard traditional entry admissions CR program (TRAD). Primary outcome data indicate that both groups completed more MVPA after 1 month of CR (TRAD, 41 ± 20 min; CONTIN, 61 ± 27 min), but this effect was not maintained at 4 months or 6 months. Additionally, physical parameters and psychosocial measures also improved over time in both groups. However, no difference between groups was detected at any time for the change in MVPA or any other parameter.

Several factors may explain our results. For example, although a rolling, continuous entry admissions CR program model was implemented in this project, no differences were observed between groups for the days from referral to entry in the CR program. This outcome was unexpected because the CONTIN program utilized a rolling, continuous entry admissions model, where new patients could join the existing CR cohort every second day rather than having to wait until the start of the new session (which in some cases may require a 30 day wait period). The recommended wait times for CR vary depending on the cardiac condition, but in general, is less than 30-60 days for conditions such as angina, myocardial infarction and coronary artery bypass graft surgery[5]. Therefore, the time from referral to entry into the CR program (TRAD 41± 6 days, CONTIN 47± 6 days) observed in our study are within the recommended 60 day period. Although we did not design this study to identify factors that influence time from referral to entry into CR, the literature indicates that a combination of program factors and patient factors are important. For example, program factors that are known to influence wait times include the referral process itself, the time it takes to process it, patient contact after referral, and CR intake session[5]. Our study manipulated one program factor, namely program entry model, which was intended to enable patients to enroll in the program as soon as they were ready to start CR. However, our data show that manipulation of this factor did not reduce wait times between the two groups. Therefore, we suggest that the program entry models utilized in this study did not directly limit patient enrollment within the CR program utilized within this study. It is possible that patient factors, such as the patients' readiness to enroll in CR, had stronger impact in this study. For example, previous literature indicates that patient factors such as social supports, timing, distance to the CR facility, benefits and barriers of exercise all influence a patients decision to start CR after they receive a referral. It is important to indicate that the lack of a difference between groups for the time from referral to entry in the CR program observed in this study may have occurred because patient demographics, frequency of cardiac events prior to referral, risk factors and medications did not differ between groups at baseline. Therefore, it is possible that the lack of differences between patient factors amongst the study groups contributed to the lack of change in time from referral to entry between groups.

The primary outcome variable, change in MVPA as measured by accelerometery, increased when assessed at 1 month and then returned toward baseline levels when measured at 4 and 6 months. This pattern of change in MVPA is similar to that observed in other studies that have examined physical activity adherence after CR[9, 10]. For example, Guiraud et al.[10] provided accelerometer data looking at short term adherence (2 months) and long term adherence (1 year) to meeting physical activity guidelines after CR. That study found that only 53% of the CR group were meeting physical activity guidelines 2 months after CR. Moreover, exercise adherence had dropped to 41% at 12 months.

Accelerometer data indicate that participants in both groups tended to accumulate more light intensity physical activity at 1, 4 and 6 months, as compared to baseline. This observation contrasts the data presented by Guiraud et al[10] who demonstrated a decrease in light activity from 2 month post CR to 12 months post CR. It is also notable that the change in light intensity physical activity observed in our study was not associated with a similar magnitude of change in MVPA. In fact, the number of participants in each group who were classified as meeting Canada's Physical Activity Guidelines was not different between groups at any time. With this in mind, it is important to indicate that Canada's Physical Activity Guidelines recommend that adults accumulate 150 minutes of MVPA in bouts of 10 minutes or longer on most days of the week in order to achieve optimal health benefits. This recommendation is supported by the observations of Slørdahl et al.[25], who demonstrated that MVPA improves VO_{2peak} levels more than low intensity activity. Additionally, Tanasescu et al.[26] have demonstrated that moderate and vigorous intensity exercise reduce the risk of cardiac events by 6% (risk reduction, 0.94; 95% CI, 0.83-1.04) and 17% (risk reduction, 0.83; CI, 0.72-0.97), respectively, as compared to low intensity activity.

We purposefully collected physical activity data using accelerometery as well as the IPAQ self-report. Notably, the IPAQ indicates that MVPA progressively increased over time, which was not observed by the accelerometer data. This type of discrepancy is common amongst studies that employ self-reported measures of physical activity[27, 28]. Even so, the IPAQ questionnaire is considered to be a valid and reliable measure of physical activity. Furthermore, we identified a positive correlation ($r=0.151$, $p <0.05$) between the IPAQ MVPA and MVPA completed in bouts of 10 minutes or longer assessed by accelerometery, which is consistent with published literature[27]. It is well established that participants often misjudge the intensity of physical activity that they have done, which contributes to the over-reporting of moderate and vigorous physical activity[27].

Another notable observation made in our study is that sedentary behaviour, which was assessed using accelerometery in bouts of 10 minutes or longer, was reduced by as much as 33% after the completion of the CR program, as compared to baseline. This observation supports the findings of Vasiliauskas et al.[29], who demonstrated that a 4 week CR program was able to reduce sedentary lifestyle by 5%; whereas, a 6 month CR program reduced sedentary behaviour by 31%.

As expected, both CR programs led to the improvement of patient physical parameters. For example, VO_{2peak} improved following the 4 month CR program in both group. Additionally, participants successfully reduced their waist to hip ratio, which is an indicator of central obesity, following the 4 month CR program, as compared to baseline. This is a positive outcome because central obesity is a known cardiovascular risk factor. Both groups also improved their 6MWT and 5mGS scores progressively over time. These improvements in functional walking ability were correlated with the change in VO_{2peak} after the completion of the 4 month CR program, as compared to baseline. These outcomes are clinically relevant because previous studies have shown that lower scores on the 6MWT and 5mGT are associated with worse cardiovascular outcomes[30].

In general, the literature indicates that psychological factors such as mood disturbances, fatigue, depression and emotional health scores are all improved by participation in CR. For example, a study by Beniamini et al.[31] demonstrated that strength training was able to reduce depression by 73%. Very few participants in our study reported signs of depression based on their PHQ-9 responses. Nonetheless, our data indicate that the general mood status improved over time. We also were able to identify a correlation between PHQ-9 scores and IPAQ MVPA. This follows the trend in literature which supports the inverse relationship seen between physical activity and depression[1].

Our data provide evidence indicating that cardiac anxiety was reduced over time in both groups. Furthermore, our data identified a correlation between CAQ scores and IPAQ MVPA. In general, these data support the findings of Duarte et al.[32], who published evidence indicating that even a 4-week cardiac rehabilitation program was able to reduce anxiety in a patient.

Although the overall SF-36 general health score was not influenced, several subscales of the SF-36 survey were improved by participation in CR. In fact, our data indicates that improvements in physical functioning were associated with the amount of MVPA accumulated in 10 minute bouts of activity or longer. This relationship highlights the connection between being able to physically perform one's day-to-day tasks and the optimal health benefits of MVPA[33]. For example, Chou et al.[33] have previously published data indicating that increased physical activity improved activities of daily living in an elderly population (weighted mean difference = 5.33; 95% CI 1.01-9.64).

Several CR program factors may explain why the two groups responded in a similar manner in our study. For example, both the TRAD and CONTIN programs were structured in a way that had participants attend 1 month of classroom-based education and a structured physical activity program, where support staff worked with the participants to develop a physical fitness plan for the individual. After the first month of CR was completed, the participants were then provided with open access to attend the CR facility for an additional 3 month period but were not provided with classroom-based education. As such, the supports received during the first month of the program were highly structured compared to later in the program (i.e. month 2 to 4 of CR). This notion is supported by the literature, which indicates that different types of program supports (such as emotional, informational and affirmational supports) help patients to learn new coping skills[13]. Furthermore, staff guidance and program support structure are both known to promote better adherence to a more physically active lifestyle[1, 12]. The correlation between the number of sessions attended and the change in VO_{2peak} observed in our study further support the notion that program support structure contributes to improved outcomes. An alternative interpretation is that patients who attend CR more frequently improve their aerobic fitness more than do patients who do not utilize the supports offered by the CR program.

In conclusion, our research shows that structured cardiac rehabilitation programs are effective in increasing physical activity in a clients' life, improving physical parameters and psychosocial factors. However, given that the continuous entry model did not reduce the time from referral to entry into CR, we suggest that patient factors, rather than program factors, had a stronger influence on wait times in this study. Therefore, future studies should focus on ways to address patient factors that influence time from referral to entry into CR. Additionally, the fact that changes in physical activity behaviour peaked after 1 month of CR and then returned to baseline levels suggests that CR program support is an important factor that influences participant adherence to a more physically active lifestyle. Therefore, CR programs should identify ways to optimize how different types of program supports are delivered in order to optimize the adoption and maintenance of healthy living initiatives.

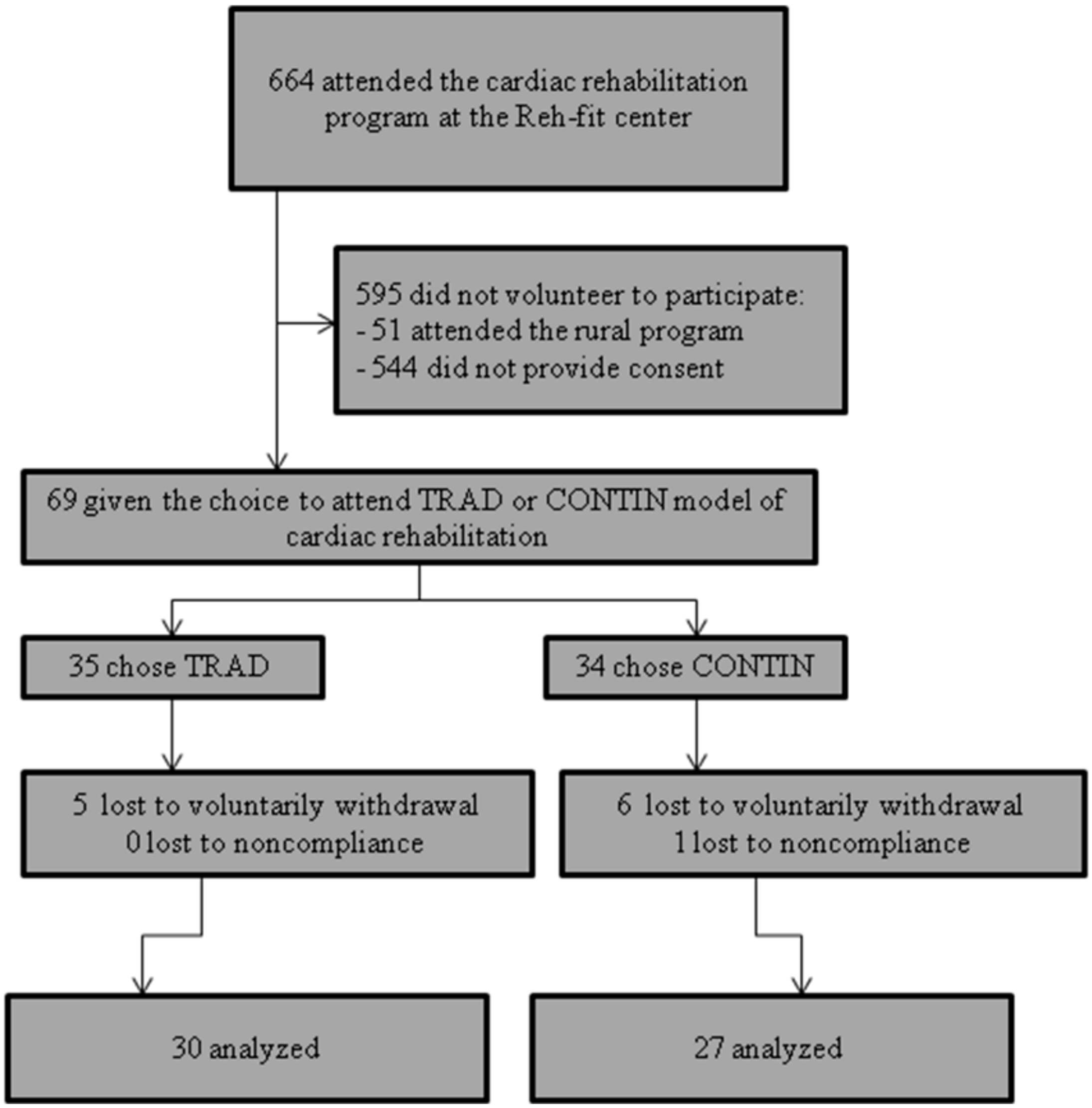

Figure 1: Flow diagram of the clients participating in the cardiac rehabilitation programs at the Reh-fit Center. This diagram represents the clients who participated in the traditional entry model (TRAD) and the continuous entry model (CONTIN) and a brief summary about the participation details of each model.

Table 1: ***Baseline participant characteristics, risk factors and medication use.***

	TRAD	CONTIN
Age	63 ± 2	59 ± 2
Cardiac Rehabilitation		
Days from referral to entry	41 ± 6	47 ± 6
Number of sessions attended	38 ± 4	30 ± 3
Frequency of Cardiac events prior to entry		
Angina	22 (63%)	19 (56%)
Myocardial infarction	16 (46%)	22 (65%)
CABG	5 (14%)	9 (27%)
Valve	3 (9%)	6 (18%)
Aneurysm	1(3%)	2 (6%)
Pacer/ICD	5 (14%)	2 (6%)
Arrhythmia	8 (23%)	8 (24%)
Risk Factors		
Men	27 (77%)	26 (77%)
Diabetes	6 (17%)	8 (23%)
Left ventricular ejection fraction (%)	56 ± 3	57 ± 3
Sedentary lifestyle	12 (34%)	11 (32%)
High cholesterol	20 (57%)	17 (50%)
Hypertension	19(54%)	19(56%)
Obesity	10(29%)	8 (24%)
Diabetes	6 (17%)	8 (24%)
Depression	8 (23%)	8 (24%)
Medications used by clients participating at baseline		
ACE inhibitors	15 (43%)	11 (32%)
β-blockers	25 (71%)	18 (53%)
Statins	27 (77%)	22 (65%)
Antiplatelet	33 (94%)	28 (82%)
Nitro	16 (46%)	11 (32%)
Calcium channel	3 (9%)	3 (9%)
ARBS	1 (3%)	2 (6%)

Data are reported as mean ± SE for days of referral to entry, number of sessions attended, age and left ventricular ejection fraction. All other data are reported as frequency (% of group). Data for the listed parameters were collected following a chart-review of participant files collected by the Reh-fit Center. TRAD, Traditional entry group. CONTIN, continuous entry group. medications were recorded on the Medication form found in the clients individuals charts. Medications were reported verbally by the participant or were brought in where the nurses recorded the information.

Table 2: ***Accelerometers were used to collect information on the type and quantity of physical activity done by the clients in both the traditional and continuous group.***

	Time			
	Baseline	1 month	4 month	6 month
Accelerometer 10 minute or longer bouts of activity				
Changes in MVPA				
TRAD		41 ± 20	-4 ± 17	-20 ±13
CONTIN		61 ± 27	11 ± 16	-1 ± 26
Changes in total physical activity				
TRAD		89 ± 27	40 ± 25	10 ± 21
CONTIN		61 ± 27	15 ± 24	2 ± 31
Meeting Canada's Physical Activity guidelines (number of people)				
TRAD	3 (9%)	6 (17%)	2 (6%)	2 (6%)
CONTIN	5 (15%)	10 (29%)	5 (15%)	4 (12%)
Total MVPA				
TRAD	51 ± 15	92 ± 24	47 ± 13	31 ± 9
CONTIN	77 ± 16	138 ± 29	87 ± 18	76 ± 26
Total light physical activity				
TRAD	10 ± 3	58 ± 25	53 ± 27	42 ± 19
CONTIN	51 ± 13	51 ± 13	56 ± 17	54 ± 16
Sum of physical activity				
TRAD	47 ± 15	122 ± 29	84 ± 28	71 ± 27
CONTIN	102 ± 16	155 ± 22	120 ± 22	97 ± 20
Sedentary				
TRAD	3858 ± 268	4249 ± 338	3071 ± 171 [b]	3342 ± 389
CONTIN	4082 ± 309	3683 ± 193	3999± 445	2759 ± 306 [a, b, c]
Accelerometer sporadic bouts of activity				
Sporadic MVPA				
TRAD	536 ± 103	943 ± 166	626 ± 126	424 ± 74
CONTIN	801 ± 97	1053 ± 187	761 ± 89	597 ± 119
Sum of sporadic physical activity				
TRAD	1222 ± 131	1822 ± 246	1435 ± 191	1229 ± 113
CONTIN	1743 ± 126	2033 ± 225	1740 ± 118	1487 ± 140
IPAQ data				
IPAQ MVPA (min/week)				
TRAD	161 ± 62	414 ± 73	540 ± 103	515 ± 82
CONTIN	204 ± 74	419 ± 70	539 ± 90	525 ± 109
Average IPAQ minutes of daily physical activity (minutes/week)				
TRAD	338 ± 76	637 ± 101	870 ±129	851 ±116
CONTIN	605 ± 102	822 ± 110	987 ± 144	952 ± 146
Functional walking capacity				
6MWT (meters)				
TRAD	521 ± 19	557 ± 20	570 ± 22	580 ± 23
CONTIN	528 ± 23	566 ± 22	590 ± 22	595 ± 22
5mGT (seconds)				
TRAD	3.4 ± 0.1	3.1 ± 0.1	3.0 ± 0.1	3.0± 0.1
CONTIN	3.6 ± 0.2	3.3 ± 0.1	3.2 ± 0.1	3.1 ± 0.1

Data are reported as mean ± SE. TRAD, Traditional entry group.. CONTIN, continuous entry group. A 2 way ANOVA was utilized to detect differences between means. Change in MVPA reflects the difference of moderate and vigorous physical activity as compared to baseline. A main effect of time ($p < 0.001$) was identified for Change in MVPA, where baseline < 1 month and 1 month > 4 and 6 months. Similar differences were seen for 10 minute Total MVPA, 10 minute Total light minutes and the sum of physical activity (i.e. the sum of light, moderate an vigorous physical activity completed in 10 minute bouts or longer; $p<0.005$) where baseline < 1 month, and 1 month > 4 and 6 months. An interaction ($p < 0.05$) between group and time was identified for 10 minute bouts of sedentary time; where [a] different from baseline of that same group, [b] different from 1 month, [c] different from 4 months. A main effect of time was identified for Sporadic MVPA and Sum of sporadic physical activity, ($p<0.005$) where baseline < 1 month and 1 month > 4 and 6 months. There was also a main effect of group ($p<0.05$) identified for the sporadic MVPA where TRAD < CONTIN. 6MWT, 6 minute walking test. 5mGT, 5 meter gait speed test. A main effect of time ($p < 0.001$) was observed for 6MWT, where the baseline < 1month < 4 and 6 months. A main effect of time ($p < 0.001$) was also observed for 5mGT, where baseline > 1, 4 and 6 months, and 1 month > 6 months. Data are reported as mean ± SE and frequency (%) for IPAQ class. MVPA, sum of self-reported moderate and vigorous physical activity within the past 7 days. A 2 way ANOVA analysis identified a main effect of time ($p< 0.001$) for IPAQ MVPA ($p< 0.001$), where baseline < 1, 4 and 6 months. A main effect of time for Average IPAQ minutes of physical activity/day was also identified, where baseline < 1 < 4 and 6 month. IPAQ data was used to categorize participants into those meeting/not meeting Canada's physical activity guidelines of at least 150 minutes of moderate to vigorous intensity physical activity.

Table 3 ***Self-reported symptoms of depression and cardiac-specific anxiety amongst the traditional and continuous groups.***

	Time			
	Baseline	1 month	4 month	6 month
Symptoms of depression				
PHQ-9 Total Score				
TRAD	4 ± 1	3 ± 1	2 ± 1	3 ± 1
CONTIN	5 ± 1	3 ± 1	3 ± 1	3 ± 1
Number of participants reporting symptoms of depression (frequency and % of group)				
TRAD	9 (26%)	4 (11%)	5 (14%)	8 (23%)
CONTIN	11 (32%)	4 (12%)	6 (18%)	4 (12%)
Anxiety				
CAQ Total Score				
TRAD	25 ± 2	24 ± 1	22 ± 1	21 ± 2
CONTIN	26 ± 2	23 ± 2	21 ± 2	21 ± 2
CAQ Subscale 1: Fear				
TRAD	12 ± 1	11 ± 1	10 ± 1	10 ± 1
CONTIN	12 ± 1	11 ± 1	10 ± 1	10 ± 1
CAQ Subscale 2: Avoidance				
TRAD	9 ± 1	6 ± 1	6 ± 1	5 ± 1
CONTIN	8 ± 1	6 ± 1	5 ± 1	5 ± 1
CAQ Subscale 3: Heart focused attention				
TRAD	5 ± 1	6 ± 0 [a]	6 ± 1 [a]	5 ± 1
CONTIN	6 ± 1 *	6 ± 1	6 ± 1	6 ± 1
Health Perceptions				
SF 36: General Health (%)				
TRAD	65 ± 3	69 ± 3	71 ± 3	70 ± 3
CONTIN	72 ± 3	71 ± 3	72 ± 3	74 ± 4
SF 36: Physical Functioning (%)				
TRAD	68 ± 4	82 ± 2	81 ± 3	83 ± 3
CONTIN	75 ± 4	83 ± 3	87 ± 3	90 ± 2
SF 36: Role Limitations due to physical health (%)				
TRAD	32 ± 7	50 ± 7	68 ± 7	65 ± 8
CONTIN	40 ± 8	61 ± 8	69 ± 8	80 ± 7
SF 36: Role Limitations due to emotional problems (%)				
TRAD	66 ± 8	79 ± 7	84 ± 6	87 ± 5
CONTIN	70 ± 7	81 ± 6	84 ± 6	90 ± 5

Data are reported as mean ± SE and frequency (%) for number of participants reporting symptoms of depression. TRAD, Traditional entry group. CONTIN, continuous entry group. PHQ-9, Patient Health Questionnaire- 9. A main effect of time ($p < 0.005$) was identified for PHQ-9, where baseline > 1, 4 and 6 months. Number of participants reporting symptoms of depression represents the number of patients who were classified as reporting minimal or more severe symptoms of depression based on PHQ-9 criteria. CAQ, Cardiac Anxiety Questionnaire. A main effect of time ($p < 0.01$) was identified for total CAQ score, fear, and avoidance. For total CAQ score, baseline > 1 month > 4 and 6 month. For CAQ fear, baseline > 4 and 6 months. For CAQ avoidance, baseline > 1 month > 4 and 6 month. [a] different from baseline ($p < 0.05$). * different from TRAD ($p < 0.05$). SF-36, short form 36 health questionnaire. Physical functioning showed a main effect of time ($p < 0.001$), where baseline < 1, 4 and 6 months. Role limitations due to physical health had a main effect of time ($p < 0.001$), where baseline <1 month < 4 and 6 months. Role limitations due to emotional problems showed a main time effect ($p < 0.001$) where baseline < 1, 4 and 6 months.

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