# Community-Based Cardiac Rehabilitation Maintenance Programs: Use and Effects

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**Abstract**

**Background:** Cardiac rehabilitation (CR) graduates are encouraged to attend maintenance programs to promote long-term physical activity and preserve gains in function. This study describes the characteristics, attendance and physical function of community-based maintenance CR participants, compared to primary prevention participants.

**Methods:** In this cross-sectional study, participants from two programs in New Zealand completed an interview, anthropometry, functional assessments (walking tests, chair stand test, handgrip strength), a 12-month physical activity recall, and a cardiopulmonary exercise test (subsample only). Attendance was ascertained from club records.

**Results:** Participants (n=56, 55.4% Secondary Prevention) attended 37.4±27.9% of sessions annually. Participants were predominately New Zealand-European (93.5%), retired (80.2%), married (68.3%) elderly individuals, with musculoskeletal problems (60.0%), who lived proximate to the clubs. In Secondary but not Primary Prevention participants, first-year attendance was strongly correlated with attendance in subsequent years ($p<0.001$). In all participants, greater attendance in the previous 12 months was significantly associated with lower waist circumference, and greater shuttle walk test duration, chair stands and balance ($p<.05$). Session attendance was positively correlated to peak oxygen consumption ($p=0.041$) in Secondary Prevention participants only.

**Conclusion:** Participation in community-based CR maintenance programs is associated with health benefits but these programs are not accessed by a diversity of patients.

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## Introduction

Participation in outpatient cardiac rehabilitation (CR) reduces all-cause mortality after myocardial infarction[1], percutaneous coronary intervention[2] and coronary artery bypass surgery[3]. Higher attendance at outpatient CR sessions is associated with greater survival benefits[4, 5]. However, the short duration of outpatient CR programs (4 to 12 weeks)[6], high drop-out rates[7, 8], and poor adherence to exercise post-program[9, 10] diminishes the mortality benefits that could ultimately be achieved.

CR programs endeavour to promote long-term exercise adherence in graduates by promoting their transition to maintenance programs. Only a few previous studies to date have investigated these extended (>1 year) maintenance CR programs[8]. Brubaker et al.[8] reported improved body composition, functional capacity and lipoprotein profile in cardiac patients participating in an extended CR program. Gayda et al.[11] reported improved exercise capacity, management of cardiovascular risk factors, and slowing down of age-related decline in exercise capacity in elderly cardiac patients participating in a long-term CR program.

Given the lack of CR capacity, delivering CR programs in the community setting has the potential to reach more patients [12]. Moreover, these programs could be located in closer proximity to where patients live, further enhancing access. There has been limited investigation of community-based CR maintenance programs, despite suggestions that such programs could improve exercise capacity and facilitate management of cardiovascular risk factors [8, 11] . We previously reported on elderly cardiac patients participating in a community-based CR maintenance program[13] . During the 1.6-year follow-up, participants improved lower-body muscle strength, but experienced a decline in handgrip

strength and unfavourable changes in body composition, regardless of attendance rates[13] .

No previous study has examined the sociodemographic and clinical characteristics, as well as attendance patterns in individuals participating in community-based maintenance CR programs. In New Zealand, there are over 40 such community-based CR maintenance “clubs”. The purpose of this study was to describe: (1) sociodemographic and clinical characteristics of attendees, (2) attendance rates over time, as well as (3) body composition, physical function and physical activity in individuals participating in community-based CR maintenance programs. Primary and secondary prevention participants were compared.

**Materials and Methods**

**Participants.** Individuals who participated in one of the two local community-based programs were approached. Based on their history of cardiovascular disease, participants were classified into Primary Prevention (no history of cardiovascular disease) or Secondary Prevention (documented cardiovascular disease) groups. Coronary artery disease was documented as a self-reported history of myocardial infarction, percutaneous coronary intervention and/or coronary artery bypass graft surgery, verified through medical records. Primary Prevention patients were invited to participate to serve as a comparison group for attendance and physical outcomes.

Participants were recruited between October 2010 and February 2012 as a part of two different studies. Exclusion criteria were: 1) myocardial infarction or admission to the hospital with chest pain in the previous 6 months; 2) chest pain at rest; 3) significant palpitations; 4) moderate to severe aortic stenosis; 5) significant dyspnea and swelling, and 6) inability to perform a walking test. All participants

were offered written and verbal information about the study, and signed a consent form. Both studies were approved by the Lower South Regional Ethics Committee and the University of Otago Ethics Committee.

**Setting.** Participants were recruited from two "clubs" in Dunedin, New Zealand: The Otago Phoenix Club (established in 1968; 114 members in 2011) and Taieri Fit and Fun Group (established in 2004; 128 members in 2011). Referral of Secondary Prevention patients to both of these clubs was via "graduation" from the local CR outpatient program and in some cases with a direct referral from a cardiologist. Primary Prevention patients were generally not referred to the clubs but they could gain access via direct referral from a cardiologist or general practitioner, or as a spouse of the referred patient.

The nature of these community-based CR maintenance programs has been described previously[13]. Briefly, both programs offered two supervised 60-minute group exercise sessions per week, consisting of a combination of aerobic, strength, flexibility, balance and coordination exercises. Exercise sessions were led by a physiotherapist or an exercise specialist. The clubs formed a committee of interested members and elected executive officers. The committee of one of the clubs had subgroups to organise walking and tramping events, track clearing activities, liaison with the therapeutic pool trust and social events. The club treasurer managed the funds obtained from annual subscriptions and grants, arranged for reimbursement of expenses for the exercise supervisor and paid a donation for use of the venue. The committees of both clubs applied for grants as a charitable organisation to purchase additional equipment and pay their exercise facilitators. Both clubs had regular social events. The clubs' websites and newsletters focused on healthy lifestyle and issues related to heart

disease. Members supported one another by offering transport, hospital visiting, and helping with lawn mowing and heavy chores. The social support network was a very important part of the groups' function. One club had an annual membership fee while the other worked on a user pays basis. Both groups trained their members in cardiopulmonary resuscitation and safety awareness.

**Study Design and Procedures.** In this cross-sectional study, all participants attended a study visit during which they were interviewed about their medical history and physical activity habits, and completed anthropometry assessments and physical function testing. As a part of one of the studies, a subset of participants performed a symptom-limited graded exercise stress test, during an additional study visit within 2 weeks.

**Measures**

**Sociodemographic characteristics and medical history.** Participants were interviewed about their sociodemographic characteristics, cardiovascular risk factors, symptoms, medication and comorbidities. Home address data were used to calculate distance to a community maintenance CR programme using Google Maps and determine neighbourhood area deprivation score as a surrogate for participants' socioeconomic status [14]. New Zealand Index of Deprivation was obtained by matching meshblock codes for the addresses with New Zealand 2006 Census data. The deprivation index is an ordinal scale ranging from 1 (least deprived) to 10 (most deprived).

**CR club participation.** CR attendance data were available from both club records. Attendance data from the 5 years prior to the study were used to calculate the percentage of sessions attended for each participant, with the denominator based from the participants first session, assuming participation in 2

sessions per week as offered. CR club membership duration was calculated from the first CR exercise session attended.

**Anthropometry and body composition.** Anthropometry (height, weight, waist and hip circumference) and bioimpedance-based body composition measurements (Biospace InBody 230) were performed, and have been described in detail elsewhere [13, 15]. All measures were taken twice, with the average used in the analyses.

**Physical function.** Assessment of physical function included the 6-minute walk test, 10-meter shuttle walk test, Short Physical Performance Battery, handgrip strength, 30-second chair stand test and 30-second balance test, using previously-described protocols [15].

**Physical activity.** Self-reported physical activity over the past 12 months were assessed in an interview, as described previously [13]. Briefly, participants reported the mode, frequency, duration and self-perceived intensity of their regular physical activities in the previous 12 months [16, 17]. Metabolic equivalents (METs) of each activity were determined from the Physical Activity Compendium[18]. The total amount of time spent in each moderate to vigorous-intensity physical activity (≥3.0 METs) multiplied by corresponding METs for each activity was used to calculate energy expenditure in kilocalories using the following equation: kilocalories$\cdot h^{-1}$ = MET $\times$ weight (kg) $\times$ duration (hours) [18]. Based on average weekly energy expenditure, participants were categorized as sedentary (<1000 kcal/week), moderately active (1000-1999 kcal/week), or very active (≥2000 kcal/week) [17].

**Exercise Capacity.** A subgroup of 73 participants performed a symptom-limited cardiopulmonary exercise test with expired gas analysis (Quark CPET,

Cosmed, Rome) and continuous 12-lead ECG monitoring (Quark C12x INT w/TTL, COSMED, Rome). The cardiopulmonary exercise test was performed on a cycle ergometer (COSMED 100K, Rome) using a ramp protocol, as described previously[15]. Participants took their usual medications on the day of the test. Ventilatory threshold was determined visually by two independent observers using the V-slope method. Age- and sex-predicted peak oxygen consumption was calculated using Wasserman and Hansen equations for exercise testing performed on a cycle ergometer.[19]

**Statistical Analysis.** Sociodemographic and clinical characteristics and attendance rates were analysed using descriptive statistics. Pearson Product Moment correlations and partial correlations were used to examine the association between attendance and outcomes. Differences between the groups were compared using independent samples t-test for continuous variables, and the Chi-square test for categorical variables. Due to sex differences, anthropometry, physical function and cardiopulmonary test results were compared between the groups using ANCOVA with sex as a covariate. P-values less than 0.05 were considered statistically significant. Data were analysed using SPSS Version 19.0.

## Results

### Participant Characteristics

One hundred and one club members agreed to participate (recruitment rate 41.7%), and were similar to non-participants with respect to age and sex distributions. Fifty-six (54.5%) participants had a history of cardiovascular disease, and comprised the Secondary Prevention group (Table 1). Secondary Prevention participants had their first and last cardiac event 9.1±7.7 and 6.1±5.6 years prior to the study, respectively (Table 1). Fourty-seven (85.5%) participants

had a documented history of coronary artery disease before the CR-inciting event. Compared to Primary Prevention participants, Secondary Prevention participants were more often male (Table 1) and had a greater risk factor burden, symptom burden, and use of cardiovascular medications (Table 2). The groups were similar with respect to all other sociodemographic characteristics.

**Club Use**

On average, participants attended 37.4±27.9% of the twice-weekly exercise sessions in the previous year, with no significant difference between groups (Figure 1). The average annual attendance over the 5 years was 42% of weekly exercise sessions in both groups (Figure 1). However, Secondary Prevention participants travelled longer, and attended for more years, than Primary Prevention participants (Table 1).

In Secondary Prevention participants, first year attendance was strongly and consistently correlated with attendance in subsequent years (Table 3). Annual attendance rates were not consistent for the Primary Prevention participants, where a significant correlation was observed only with the most recent year (Table 3). In all participants, greater session attendance in the previous 12 months had weak but significant associations with shorter membership duration ($r=-.23$; $p<0.05$).

**Functional Outcomes**

Anthropometry, physical function and physical activity data are shown in Table 4. In the Secondary Prevention group, 34 (60.7%) participants were overweight, 10 (17.9%) obese and 33 (58.6%) had a waist circumference above the guideline-recommended threshold. The Secondary Prevention group had an average peak oxygen consumption as expected for healthy individuals of the

same age and gender (Table 4), with 24 (57.1%) individuals with peak oxygen consumption over 18 ml/kg/min (above the threshold for independent living) and 41 (73.2%) individuals without an impairment in physical function assessed by Short Physical Performance Battery. With regard to physical activity, approximately one-third of these participants were sedentary.

Differences in anthropometry, body composition and handgrip strength were observed between the groups. However, these differences did not sustain adjustment for sex. In the subset of participants who performed the cardiopulmonary exercise test, percentage of the age- and sex-predicted peak oxygen consumption was significantly lower in the Secondary Prevention versus the Primary Prevention group (Table 4). No other significant differences were observed in physical function and exercise capacity between the groups. Finally, Secondary Prevention participants were significantly more active than their Primary Prevention counterparts.

In all participants, session attendance in the previous 12 months had weak but significant ($p<.05$) associations with waist circumference ($r=-.24$) and physical function (shuttle walk test duration [$r=.24$], chair stands [$r=0.24$] and balance test [$r=.25$]), but was not related to physical activity. In Secondary Prevention participants, session attendance was positively correlated to peak oxygen consumption ($r=0.32$; $p=0.04$). In the Primary Prevention group, session attendance was positively associated with shuttle walk duration ($r=.38$; $p=0.01$) and negatively associated with weight ($r=-.31$; $p<0.05$), body mass index ($r=-0.33$; $p=0.33$), waist circumference ($r=-0.36$; $p=0.02$) and hip circumference ($r=-.36$; $p=0.02$).

**Discussion**

Community-based CR maintenance programs attract elderly, white, married, retired males who live in close proximity to the program. The majority of participants had musculoskeletal problems. Cardiac medication adherence was quite good, except for ACE-inhibitors. Men were more likely to attend the clubs for secondary prevention, while women were more likely to attend for primary prevention. On average, participants attended an exercise session every week, and Secondary Prevention participants were members of the club quite consistently across the 5-year span of study. Secondary Prevention participants reported quite a high degree of cardiac symptoms that may warrant medical consultation. Participants were slightly overweight but not obese on average, with an average physical function and exercise capacity. Surprisingly, one-third of participants were sedentary (<1000 kcal/week), but Secondary Prevention participants were significantly more active than Primary Prevention participants. Among Secondary Prevention participants, greater session attendance was associated with greater functional capacity and more favourable anthropometric characteristics.

Low referral, coupled with high drop-out rates from CR programs and limited availability of CR maintenance programs in the community suggest that individuals participating in these programs are likely to be a highly select group of patients compared to patients commonly-seen in routine cardiology practice. In the present study, two-thirds of Secondary Prevention participants were male. This is is agreement with the consistent evidence that men are more likely to be referred to and participate in outpatient CR programs[20]. Similarly, many CR participants are white and married, and of moderate to high socioeconomic status. However, in contrast to the low participation rates of elderly individuals in outpatient CR

programs [5, 20], a high proportion of elderly individuals were represented in the community-based maintenance CR programs. It is possible that the community location, schedule, low cost, peer support and social activities afforded by these CR clubs are particularly appealing for older individuals. Alternatively, these programs may have evolved over time to suit the needs of the most common members, as the members self-govern the club.

Many studies report poor long-term adherence to physical activity recommendations[21, 22], worsening of cardiovascular risk factors[21, 23, 24], and a decline in exercise capacity[25] 12 to 18 months following outpatient CR. Previous studies have demonstrated a decline in exercise session adherence over time. More than half of the patients enrolled in CR maintenance programs based in health facilities drop-out within 6 months[7], and less than one-third remain in an extended CR program after 1 year[8]. In another study, exercise session attendance was highest in the first year (68%) and reduced on average by half over the following 5 years in middle-age men with coronary artery disease[26]. The current retrospective analysis of CR maintenance up to 5 years prior showed a consistent average annual CR attendance rate of ~40% (average attendance of <1 session per week). The difference in findings could be explained by the older age and retirement status in the current sample, and/or the community setting in close proximity to participants' homes. Clearly, the findings herein regarding continuance are encouraging and warrant replication in a randomized study.

In the present study, approximately one-third of club participants were considered sedentary. Although high amounts of exercise are necessary to stop progression or achieve regression of coronary artery stenosis in patients with coronary artery disease in the first year after a cardiac event, less exercise may be

sufficient if performed regularly over a prolonged period of time[26]. Considering an average energy expenditure of 230 kcal per CR exercise session[27] and an annual average attendance of <1 session per week observed in the present study, it is essential that maintenance CR programs encourage physical activity outside of scheduled supervised exercise sessions to meet the minimum physical activity guidelines (≥150 minutes of moderate-to-vigorous physical activity per week). Future studies should examine using the 'nudges' via the phone or web to promote physical activity on non-club days.

With regard to the health service implications of this study, these findings suggest that community-based maintenance CR programs are successful at attracting elderly, male participants. Ultimately, these "clubs" should aspire to attract a more diverse group of cardiovascular disease patients, so all those who would benefit from the clubs would feel welcome and sustain their participation. Moreover, given the number of participants reporting adverse cardiac symptoms and musculoskeletal problems, training of the exercise leaders should include signs and symptoms of cardiovascular distress, ensure protocols for cardiac emergencies are well-practiced, and how to manage and minimize musculoskeletal pain during exercise. Indeed the British Association of Cardiovascular Prevention and Rehabilitation offers excellent training and credentialing for community-based CR providers[28]. However, community-based CR programs may not be an adequate solution for all patients due to limited availability of such programs and participation barriers such as transportation issues, inconvenient location and/or schedule conflicts and costs[29]. Other delivery modalities such as the internet or mobile phones, and peer-led group classes could promote greater reach of maintenance CR programs.

Study limitations include the cross-sectional study design, small sample size, potentially limited generalizability of the findings due to unknown club referral and participation rates and hence possible selection bias, as well as limitations of self-report of physical activity particularly in the elderly, including recall and social desirability biases. Self-selection of highly motivated and healthier individuals who lived close to the community-based CR location may well have played a role in the observed outcomes, and particularly influenced the observed attendance rates. Patients who are highly motivated may be more likely to enrol and continue participation in long-term exercise programs including community-based CR[29]. Future studies are needed which accrue a large sample of secondary prevention patients from multiple regions and should prospectively examine attendance rates and associated outcomes, using a randomized, controlled design.

**Conclusions**

Community-based maintenance CR programs may disproportionately attract elderly, white, married, retired males with a high burden of with musculoskeletal co-morbidities. Program attendance was associated with better physical function. Maintenance CR programs should encourage physical activity outside of the regular exercise sessions to ensure participants are achieving guideline recommendations.

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## Declaration of Interest

The authors report no declarations of interest.

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Table 1. Sociodemographic characteristics and program use, by club group

| | **Primary Prevention** n=45 | **Secondary Prevention** n=56 | **p** |
|---|---|---|---|
| **Sociodemographic characteristics** | | | |
| Age (years) | 69.8 ± 6.3 | 70.7 ± 7.9 | 0.535 |
| Male sex [n(%)] | 6 (13.3) | 38 (67.9) | <0.001 |
| Ethnicity [n(%)] | | | |
| NZ European | 42 (93.5) | 52 (92.9) | |
| Maori | 1 (2.2) | 1 (1.8) | |
| Other | 2 (4.3) | 3 (5.4) | 0.967 |
| Married [n(%)] | 31 (68.6) | 38 (67.9) | 0.995 |
| Retired [n(%)] | 37 (82.2) | 44 (78.6) | 0.316 |
| University education [n(%)] | 6 (13.3) | 16 (28.6) | 0.065 |
| NZ Deprivation Score (1 to 10)* | 4.6 ± 2.5 | 4.6 ± 2.8 | 0.971 |
| **Club Use** | | | |
| Attendance in the last year (%) | 39.4 ± 22.6 | 38.3 ± 31.0 | 0.817 |
| CR membership duration (years) | 2.9 ± 2.0 | 4.5±2.2 | <0.001 |
| Distance from CR club (km) | 3.3 ± 3.2 | 5.5 ± 4.2 | 0.004 |

CR, cardiac rehabilitation; NZ, New Zealand

*1=least deprived to 10=most deprived

Table 2. Clinical characteristics of club participants, by group

| | **Primary Prevention** n=45 | **Secondary Prevention** n=56 | **p-value** |
|---|---|---|---|
| Risk factors [n(%)] | | | |
| Hypertension | 23 (51.1) | 34 (60.7) | 0.333 |
| Dyslipidemia | 16 (35.6) | 39 (69.6) | 0.001 |
| Obesity | 11 (24.4) | 10 (17.9) | 0.264 |
| Smoking | 11 (24.4) | 17 (30.4) | 0.509 |
| Diabetes | 1 (2.2) | 5 (8.9) | 0.156 |
| Family history of CAD | 9 (20.0) | 17 (30.4) | 0.237 |
| Modifiable risk factors* [n(%)] | | | |
| None | 12 (26.7) | 8 (14.3) | |
| One | 16 (35.6) | 11 (19.6) | |
| Two | 9 (20.0) | 20 (35.7) | |
| Three | 5 (11.1) | 14 (25.0) | |
| Four or more | 3 (6.6) | 3 (5.4) | 0.068 |
| Total number of modifiable risk factors* (n) | 1.3±1.3 | 1.8±1.1 | 0.022 |
| Medical conditions [n(%)] | | | |
| Cardiovascular disease | 0 (0) | 56 (100) | - |
| Coronary artery disease | 0 (0) | 47 (83.4) | - |
| Musculoskeletal problems | 27 (60.0) | 32 (62.5) | 0.798 |
| Asthma | 9 (20.0) | 5 (8.9) | 0.109 |

| | | | |
|---|---|---|---|
| Breast/colon/prostate cancer | 6 (13.3) | 4 (7.3) | 0.315 |
| Depression | 6 (13.3) | 6 (10.7) | 0.686 |
| Anxiety | 1 (2.2) | 6 (10.7) | 0.095 |
| COPD | 0 (0.0) | 1 (1.7) | 0.368 |
| Symptoms [n(%)] | | | |
| Chest discomfort with exertion | 2 (4.4) | 19 (33.9) | <0.001 |
| Dizziness, fainting or blackouts | 4 (8.9) | 14 (25.0) | 0.035 |
| Musculoskeletal pain | 9 (20.0) | 10 (18.2) | 0.818 |
| Shortness of breath | 5 (11.1) | 11 (19.6) | 0.243 |
| Lower leg cramps with short walks | 0 (0.0) | 4 (7.1) | 0.067 |
| Cardiac medications [n(%)] | | | |
| Aspirin | 10 (22.2) | 48 (87.3) | <0.001 |
| Lipid-lowering agent | 10 (22.2) | 47 (85.5) | <0.001 |
| Beta blockers | 7 (15.6) | 41 (74.5) | <0.001 |
| ACE-Inhibitors | 9 (20.0) | 23 (41.8) | 0.020 |
| Calcium channel blockers | 9 (20.0) | 12 (21.8) | 0.824 |
| Diuretics | 4 (8.9) | 5 (9.1) | 0.972 |
| Nitrates | 0 (0.0) | 8 (14.5) | - |
| GTN Spray | 0 (0.0) | 4 (7.3) | - |

ACE, angiotensin converting enzyme; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; GTN, Glyceryl trinitrate.

*Modifiable risk factors included hypertension, dyspidemia, diabetes, obesity and smoking.

Table 3. Year-to-year correlations of annual attendance at exercise sessions

| | n | Attendance duration | | | |
|---|---|---|---|---|---|
| | | 37-48 months | 25-36 months | 13-24 months | ≤12 months |
| **Primary Prevention Group** | | | | | |
| 13-24 months | 25 | | | | .76† |
| 25-36 months | 23 | | | .44* | .20 |
| 37-48 months | 16 | | .38 | .41 | .37 |
| 49-60 months | 7 | -.04 | .17 | .42 | -.25 |
| **Secondary Prevention Group** | | | | | |
| 13-24 months | 44 | | | | .89† |
| 25-36 months | 41 | | | .86† | .74† |
| 37-48 months | 37 | | .89† | .81† | .70† |
| 49-60 months | 26 | .75† | .77† | .72† | .72† |

*p<0.05; †p<0.001.

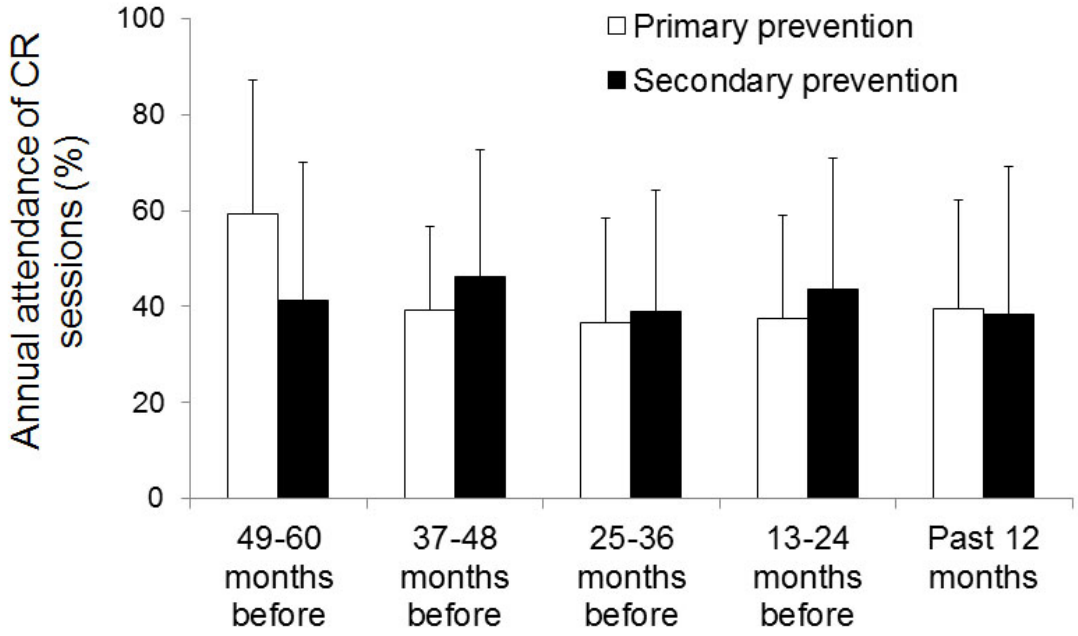
Table 4. Anthropometry, physical function, cardiopulmonary exercise test and physical activity assessments, by group

| | **Primary Prevention** (n=45) | **Secondary Prevention** (n=56) | **p** | ***p** (adjusted for sex) |
|---|---|---|---|---|
| Anthropometry | | | | |
| Height (cm) | 161.0 ± 7.0 | 168.1 ± 9.4 | <0.001 | 0.909 |
| Weight (kg) | 70.1 ± 13.3 | 77.2 ± 12.5 | 0.007 | 0.515 |
| Body mass index (kg/m$^2$) | 26.9 ± 4.1 | 27.3 ± 3.7 | 0.659 | 0.377 |
| Waist circumference (cm) | 88.8 ± 11.1 | 94.3 ± 10.4 | 0.012 | 0.519 |
| Body fat (%) | 37.0 ± 7.6 | 30.9 ± 9.2 | 0.001 | 0.967 |
| Muscle mass (%) | 35.6 ± 8.1 | 39.3 ± 7.0 | 0.017 | 0.617 |
| Physical function | | | | |
| 6-minute walk test distance (m) | 599.6 ± 93.2 | 619.0 ± 121.0 | 0.383 | 0.840 |
| Shuttle walk test duration (min) | 8.2 ± 1.6 | 8.4 ± 2.0 | 0.575 | 0.285 |
| SPPB Physical function score (n) | 11.6 ± 1.0 | 11.6 ± 0.8 | 0.953 | 0.925 |
| 30-second balance test (sec) | 20.2 ± 10.0 | 21.5 ± 10.2 | 0.551 | 0.771 |
| 30-second chair stand test (n) | 15.7 ± 4.4 | 16.2 ± 5.4 | 0.611 | 0.664 |
| Handgrip strength index | 24.1 ± 6.7 | 31.6 ± 10.2 | <0.001 | 0.717 |

| | | | | |
|---|---|---|---|---|
| (kg·F) | | | | |
| Physical activity categorization [n(%)] | | | | |
| Sedentary (<1000 kcal/week) | 16 (35.6) | 17 (30.4) | | |
| Moderately active (1000-1999 kcal/week) | 18 (40.0) | 11 (19.6) | | |
| Very active (≥2000 kcal/week) | 11 (24.4) | 28 (50.0) | 0.018 | - |
| Cardiopulmonary exercise test | (n=31) | (n=42) | | |
| Peak workload | 102.0 ± 24.7 | 115.1 ± 34.1 | 0.074 | 0.479 |
| $VO_{2\ AT}$ (ml/kg/min) | 14.9 ± 3.6 | 15.0 ± 4.0 | 0.879 | 0.113 |
| $VO_{2\ peak}$ (ml/kg/min) | 19.0 ± 3.8 | 19.3 ± 4.9 | 0.782 | 0.094 |
| Predicted peak $VO_2$ (%) | 105.1 ± 20.1 | 95.5 ± 19.9 | 0.047 | NA† |

SPPB, Short Physical Performance Battery; $VO_{2\ AT}$, oxygen consumption at ventilatory threshold; $VO_{2\ peak}$, peak oxygen consumption.

†Calculation of predicted $VO_{2peak}$ was based on age- and sex-specific criteria and therefore further adjustment for sex was not applicable.




| | | | | | |
|---|---|---|---|---|---|
| Primary prevention (n) | 7 | 16 | 23 | 25 | 45 |
| Secondary prevention (n) | 26 | 37 | 41 | 44 | 56 |

**Figure 1.** Percentage attendance at weekly exercise sessions, by club membership duration and group