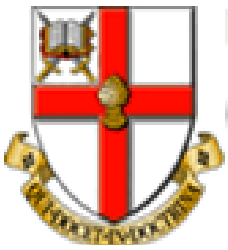

University of Chester

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In

Cardiovascular Rehabilitation

Mark Campbell

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30th September 2009

Does Resistance Training, combined with Aerobic Training, further improve Cardiovascular Fitness in Cardiac Rehabilitation Patients ?

"Dissertation submitted in accordance with the requirements of University of Chester for the degree of Master of Science."

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Signed; Mark Campbell.

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This work is dedicated to Sadie, and to Freya.

Abstract.

The primary aim of this research project was to focus on the outcomes and benefits of performing a combined cardiovascular exercise and resistance training programme in post-myocardial infarction participants. Study methods involved 18 participants (15 males, mean (M) age 61 years (SD ± 6.6), (range 45 – 72 years), and three females (M= 51 ± 8.8 years, range 43 – 63 years). Participants were randomly selected into standard care (SC) or standard care plus (SCP) groups. Each group performed 30 minutes of supervised cardiovascular exercise over a six week period; the SCP group additionally performed one set, of three resistance exercises, for 10 repetitions. Dependent t-test data gathered from a 10 metre incremental shuttle walking test prior and post-intervention demonstrates an increase in mean walking distance; the SC group by 46.9% (p = 0.01), the SCP group by 24.4% (p = 0.001). Independent t-test data demonstrates no significant findings between the groups, pre-intervention (p = 0.10), or post-intervention (p = 0.74). Significant differences were found between the pre and post-strength variables, Leg Press (p = 0.005), Back Pull-Down (p = 0.005), and the Chest Press (p = 0.007). The main conclusion to be drawn from this study is the necessity of a need to apply specificity to exercise training. A recommendation from this study would be to ensure that strength training is introduced at an appropriate time for an individual and that this component of physical training receives as much endorsement as cardiovascular exercise.

Key Words: Strength, Functional Capacity, Walking Test.

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List of Abbreviations.

10m ISWT	10 metres Incremental Shuttle Walking Test
10 RM	10 Repetition Maximum Test
1RM	One Repetition Maximum Test
BACR	British Association of Cardiac Rehabilitation
BP	Blood Pressure
BwD	Blackburn with Darwen
BwDBC	Blackburn with Darwen Borough Council
CHD	Coronary Heart Disease
CI	Confidence Interval
CR	Cardiac Rehabilitation
CRP	Cardiac Rehabilitation Programme
CV	Cardiovascular
DOMS	Delayed Onset of Muscle Soreness
DVRG	Darwen Vale Regency Gym
HADS	Hospital Anxiety Depression Scale
HR	Heart Rate
KM	Kilometre
M	Mean
m	metres
MI	Myocardial Infarction
MVO_2	Myocardial Workload
NHS	National Health Service
PCT	Primary Care Trust
RPE	Rating of Perceived Exercise
RBH	Royal Blackburn Hospital
RPM	Revolutions per Minute
RPP	Rate Pressure Product
RT	Resistance Training
SBP	Systolic Blood Pressure
SD	Standard Deviation
UK	United Kingdom

Chapter 1.

1.1: Study Background.

Coronary Heart Disease (CHD) in the United Kingdom (UK) is a common disease which accounts for approximately 95,000 deaths per annum (Allender, Peto, Scarborough, Kaur, & Rayner, 2008).

Cardiac Rehabilitation (CR) typically exists to address the individual needs of those who have suffered a non-fatal Myocardial Infarction (MI). CR programmes (CRP's) involve a team of multidisciplinary professionals and are observed as having four unique phases (Thomas et al., 2007).

Comprehensive CRP's provide an opportunity not only for individuals to increase their physical activity levels via structured exercise sessions, but to address CHD risk factors and any other associated concerns that individuals may have acquired following their illness, through the provision of educational sessions (Franklin, 1991). CRP's are also in a position to address and remove any potential barriers to social inclusion (British Association of Cardiac Rehabilitation (BACR), 2007).

A "menu" based approach, targeting the specific needs of an individual and allowing for the development of a comprehensive CRP would best serve those that require the use of such specialised services. (American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR), 2004).

Despite the many benefits associated with participation in a comprehensive CRP, not everyone suitable for such a service chooses to partake in one (Kavanagh, 2000).

1.2: Study Demography.

In the locality of Blackburn with Darwen (BwD) during 2006, there were a recorded 263 fatalities from MI. This incidence was higher than the national averages for both England and Wales. The prevalence of CHD remains high in the locality, due in part to an ageing population (Leaf, 2007).

An existing clinical pathway exists from the hospital based phase three sessions into the community based, phase four sessions. This provides for an integrated and seamless transition of patients during all of the phases, as each transpires. This pathway is enhanced by the attendance of an exercise professional during the Royal Blackburn Hospital (RBH) CRP, who is also present at the community based phase four CRP sessions. Those who are referred know the exercise professional will be in attendance and is a familiar face to welcome those referred from the hospital phase three setting into the phase four CRP. Such a practice may reduce potential anxiety levels, and as such increase participation rates.

Phase three of the RBH CRP offers a comprehensive CR service in that physical inactivity levels are addressed via the structured exercise sessions provided. Following a fifteen minute warm-up, the patient will commence the circuit class at a pre-determined exercise station (Figure 1). The circuit routine has a maximum duration of 20 minutes, depending on the patients week of attendance. No opportunity exists for the patients to perform resistance training (RT) movements that specifically allow for a progressive overload to occur. Following this component of the class, a cool-down period lasting 10 minutes is performed.

Following the exercise session a 30 minute educational session is delivered. The main topics discussed are related to the modifiable CHD risk factors which include; high cholesterol, physical inactivity, hypertension, cigarette smoking, weight management, stress and anxiety.

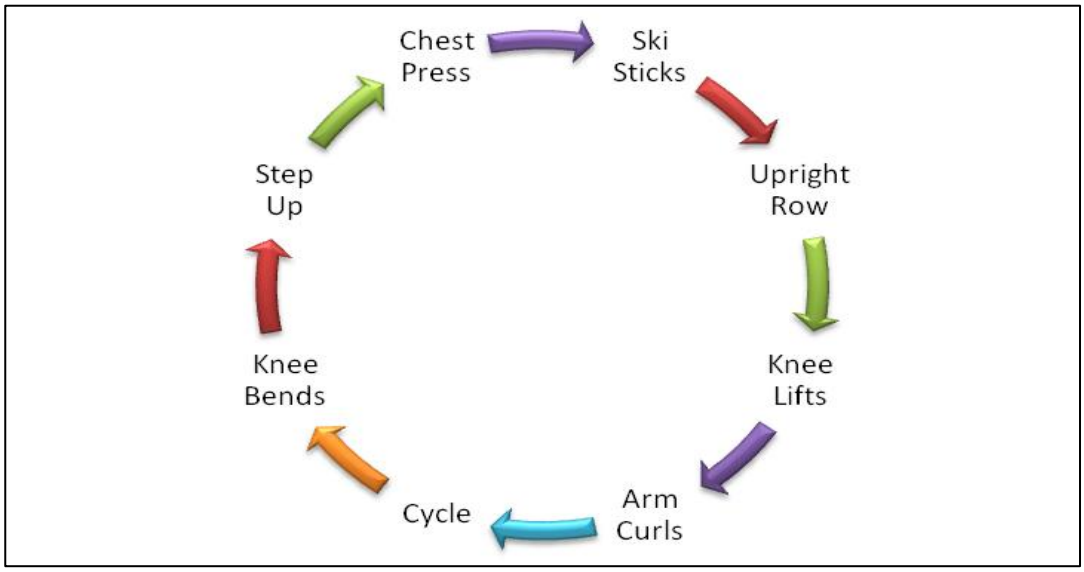

Figure 1. Royal Blackburn Hospital, Layout of Phase III circuit class.

At the conclusion of the RBH six week CRP, patients are discharged from hospital care and are then offered an opportunity to move into a phase four community based CRP. These are delivered by appropriately qualified exercise professionals, who are employed by Blackburn with Darwen Borough Council (BwDBC).

During the physical activity component of the phase four sessions, patients typically perform 35 to 45 minutes of Cardiovascular (CV) exercise on a choice of five pieces of equipment. These can be used in any order or preference (Figure 2).

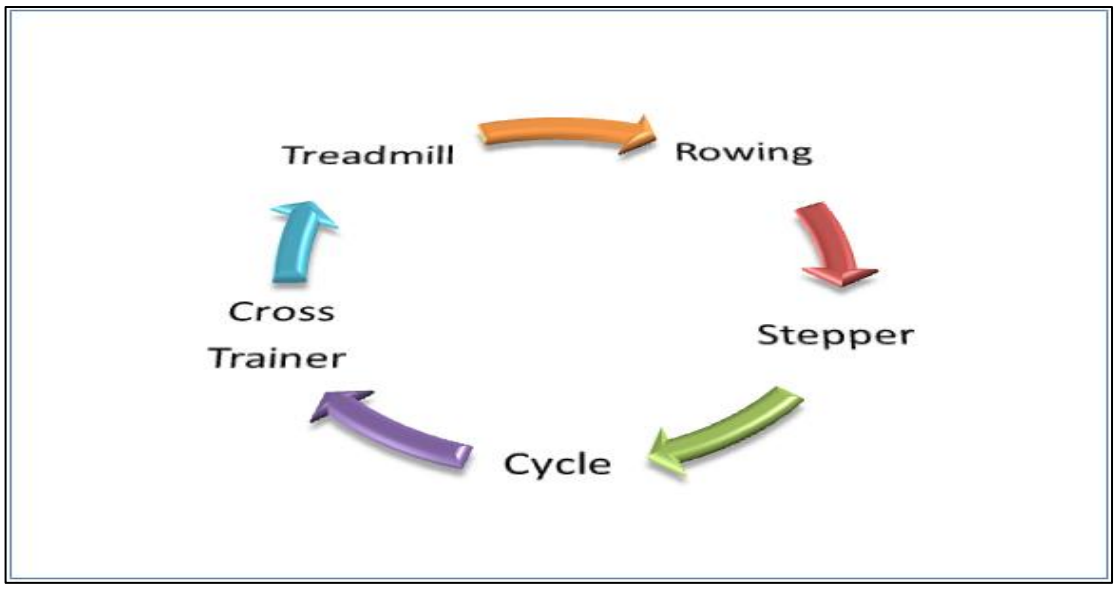

Figure 2. Phase IV community based cardiovascular equipment.

Not until the patient has attended the programme for a minimum of six weeks, are they offered RT to complement their CV programme. No clear information exists as to the reasoning why such practice prevails, as available evidence has shown the success of a high intensity RT exercise programme, that included high-risk patients who were four weeks post-event (Adams et al., 1999). International guidelines suggest the introduction of RT as a component of physical activity at five weeks post-event (Whaley, Brubaker, Otto, & Armstrong, 2006).

Having not utilised the RT equipment previously in phase three, or upon immediate progression to phase four, individuals may have become reluctant subsequently to change their physical activity routine, and may easily choose not to accept an offer to help them to do so. Such a rejection may ultimately have a deleterious effect in an individual's ability to fulfil everyday

tasks, due to the task being perceived or described as being too heavy or strenuous (Adams et al., 2006; Pollock et al., 2000).

Exercise professionals employed by BwDBC and who specifically work on the CRP possess the BACR exercise training module qualification (BACR, 2009). The training manual supplied to each instructor participating on the course details that the type of exercise training that should be intended, is that which seeks to improve the CV fitness of the individual (Bell, 2006). CRP's may unnecessarily sacrifice RT exercises for CV only exercises, based purely on the perceived negative beliefs, that RT may increase blood pressure (BP) to unsafe levels (Dingwall, Ferrier, & Semple, 2006).

Whilst the CV needs of patients are being targeted throughout their care in CRP's, RT, which is a vital component of exercise training that can assist a patient's ability to perform everyday functional tasks that involve strength, is being neglected.

Progressive RT can provide an opportunity for patients to carry out activities of daily living at an intensity level that may have once been impractical, but consequently is found to have become easier than it previously was, following such a RT programme and the development of personal strength. An increase in personal strength, which is a functional requirement of living is beneficial and requires to be developed. Laforest, St-Pierre, Cyr, and Gayton (1990), provide support for the necessity to target muscular strength. They found that muscular strength, rather than muscular endurance, is more likely to be lost through the aging process.

The physiological benefits of RT are numerous (Williams et al., 2007). Other associated benefits of strength improvements are observed in an

individual's ability to decrease concomitant hazards associated with falling (Carter, Kannus, & Khan, 2001; Lord, Clark, & Webster, 1991). The musculature of those who typically comprise CRP's, the elderly population, is noted as being thoroughly responsive to RT (Suetta, Magnusson, Beyer, & Kjaer, 2007).

Supportive evidence of the safety of RT in the presence of suitably qualified staff is presented in the work of McCartney, McKelvie, Haslam, and Jones (1991). Promotion of such findings is required to enlighten members of multidisciplinary teams, who are delivering CRP's. Such evidence in regards to the safety of RT may ensure that an effective RT programme is offered and is individually tailored to those patients who participate in CRP's.

Prior to participation in the BwDBC CRP, patients are invited to attend an initial one to one consultation with the programme leader. During the consultation the patient will take part in a 10 metre incremental shuttle walking test (10m ISWT) which aims to provide a measurement of functional capacity. Metabolic equivalents (METS) can be calculated from the performance of an individual in the 10m ISWT test (Woolf - May, Ferrett 2008), which will provide the information required to participate in other physical activities at a suitable metabolic intensity, as discussed in noted literature (Ainsworth et al., 2000). Physical activity when performed at a moderate intensity, is described as being three to six times resting values (Bucksch, 2005), and when performed should allow a participant to engage in conversation.

Pre and post-10m ISWT measurements are recorded, which include BP and heart rate (HR) measures. From these, the rate pressure product (RPP), (a calculation of systolic blood pressure (SBP) multiplied by HR and

subsequently divided by one hundred) can be calculated. RPP indirectly provides an indication of myocardial workload (MVO_2), (Bell, 2006; May & Nagle, 1984), and is deemed to be a good indicator of the oxygen consumption being utilised by the myocardium (Fardy, Franklin, Porcari, & Verrill, 1998).

The hospital and anxiety depression scale (HADS) questionnaire, provided on licence from RBH is also completed by the patient during the consultation. This questionnaire provides a psychological well-being measurement and thus provides the consultant with the present psychological status of a patient. The HADS questionnaire (Appendix A) offers an opportunity to screen patients for anxiety and depression levels. The questionnaire invites the patient to consider the previous seven days in relation to their responses (Bambauer, Locke, Aupont, Mullan, & McLaughlin, 2005).

The 10m ISWT (Appendix B) is a sub-maximal test which begins slowly, but progressively increases in speed at the end of each of the one minute stages (Singh, Morgan, Scott, Walters, & Hardman, 1992). The progressive nature of this test ensures a preparatory warm-up period is provided for the patient. There are a maximum of twelve stages, the majority of which can be walked by the patient. In the demanding latter stages of the test, a significant increase in speed is required, which involves jogging to allow the required 10 metre distance to be suitably covered.

Functional measurements recorded from the 10m ISWT at the pre-intervention stage and again at the post-intervention stage, will indicate both walking speed and walking distance, allowing for pre and

post-intervention comparisons to be made. The RPP measurements recorded from the pre and post-intervention 10m ISWT will also allow a comparison to be made to highlight any changes in resting myocardial workload (MVO_2). An increase in functional capacity may allow for a reduction in MVO_2 to be observed at the pre-10m ISWT resting state following the intervention.

1.3: Aim and Objectives.

The primary aims of this research project are to offer patients who have completed the RBH CRP, and who have been randomly selected into one of two groups, an opportunity to either perform a CV programme as per standard care (SC), or a standard care plus (SCP) programme; CV exercises in combination with RT exercises. The patient will attend once per week, for a maximum period of six weeks, and will exercise under supervision.

The information gained will determine if the addition of three specific RT exercises, combined with a 30 minute CV physical activity programme lasting six weeks, was effective in producing greater improvements in CV fitness, in comparison to a 30 minute CV exercise only programme that excluded the specific resistance exercises over the same time period.

Any improvements noted in the 10m ISWT; and a reduced RPP, could provide evidence of functional improvements.

Findings from the HADS questionnaire would provide evidence of any significant changes in the psychological status of the patients and any differences found between the two groups.

This research project will offer three specific RT exercises to those within the specified RT trial group. These RT exercises will target the major muscle groups of the body. The specific RT exercises that will be performed are a Leg Press, a Chest Press and a High Pull-Down (Appendix C).

To remove any possible confusion to the participants of having to choose between a target repetition range e.g., eight to twelve repetitions, this research project will set 10 repetitions as the goal to be achieved during the performance of the RT exercises.

A 10 repetition maximum test (10 RM) will be carried out. Fifty percent of this maximum weight load will provide the initial lifting weight of the RT component. From week two of the intervention, the aim will be to progressively increase the amount of weight lifted, through the addition of further resistance at each session. This may lead ultimately, towards a new 10 RM in the final week of the intervention. Increments on the RT equipment used are dictated by the weight blocks that can be selected via a selector pin. The Leg Press machine will only allow increments in blocks of 10 kilograms, which may be to large an increase towards the latter part of the programme. The other two RT machines can allow increments in lighter blocks at a more manageable five kilograms, which never the less may still be found to be too much of an increment to make (Appendix D).

The evidence gained from this research project will assist in the development of safe and effective physical activity programme designs for use by CR participants.

At present the BACR exercise professionals tend to introduce RT following an initial six – eight week period, if at all. This research will evaluate

the potential effectiveness of introducing a RT programme from week one of a patients attendance at a phase four session to complement their prescribed CV exercise programme.

Limitations of the study include the proposed amount of participation, due to a low referral rate from the hospital programme and the requirement of those referred to attend a specific venue. The specific nature to target only those referred following an MI will also limit participation numbers.

Chapter 2. Literature Review.

2.1: Introduction.

A literature search, between the inclusive periods of September 2008 to February 2009 was carried out, to establish existing evidence, relating to the safety and effectiveness of including RT exercises within a CRP.

Searches were carried out for non electronic sources in the University of Chester library, and for electronic sources within the online catalogues of;

- 'PubMed' (http://www.ncbi.nlm.nih.gov/pubmed),
- 'ISI Web of Knowledge' (http://www.isiwebofknowledge.com),
- 'Sport Discus' (http://www.sportdiscus.com).

Databases were searched with the keywords; "resistance training", "resistance training exercise" and "weight training". The search produced an enormous amount of literature, which was subsequently narrowed down via the addition of the keywords, "cardiac", and "rehabilitation".

A separate search in relation to anxiety and depression levels in those who were post-myocardial infarction was also completed.

2.2: Resistance Training within a CRP.

The selected reviewed studies were all primary sources and provide chronological information as to the development and inclusion of RT in a CRP.

Due to the nature of identifying primary sources and a requirement to review these studies directly, no other reviews which had been carried out and which were critically analysed (Braith & Beck, 2008; Braith & Stewart, 2006; McCartney, 1999; McCartney & McKelvie, 1996; Stewart, 1989; Vescovi & Fernhall, 2000; Volaklis & Tokmakidis, 2005) were considered for this review, but they do however provide much valuable information relevant to this research study and the actual topic of CRP and RT in this patient group.

This review considers the benefits to be gained through the addition of RT exercises to a CV exercise training routine, which is offered to those who participate in a CRP. Typically, such a CRP aims to promote and develop the CV fitness of participants (Gassner, Dunn, & Piller, 2003), with minimal (if any) consideration for the functional strength requirements of the participants.

Large bodies of work exist, (Balady, Jette, Scheer, & Downing, 1996; Hedback & Perk, 1990; Hedback, Perk, Engvall, & Areskog, 1990; Marzolini, Oh, Thomas, & Goodman, 2008) who have all carried out studies specific to the development of a CRP, and the associated benefits of performing CV exercise within such a programme.

It should be emphasised that, for strength gains to occur on a regular basis, muscles and their associated tendons and ligaments need to be progressively overloaded with a resistance that the body is unfamiliar with. These brief overload stages should then be followed by periods of (over) compensation to allow time for recovery and a positive adaptation within the muscle fibres to occur. Then the overload principle can be sensibly reapplied (Kraemer et al., 2002; Rhea & Alderman, 2004).

A summary of the primary sources that were identified and critically reviewed (table one), illustrates the key points that have been considered, with relevance to the research study and its design.

Table 1. Summary of Reviewed Research Papers.

First Named Author.	Year.	Participants.	Duration.	Frequency.	Max CV duration.	RT exercises.	% Rep maximum.	Sets / Repetitions.	Findings.
Kelemen.	1986	20 control. 20 control plus. All Male.	10 weeks.	3 x p/week.	20 mins.	8.	40%.	2 x 12 – 15.	↑ Walking Time. ↑ Strength.
Sparling.	1990	6 control. 16 control plus. All Male.	6 months.	3 x p/week.	No detail.	12.	30 % - 40% Predicted.	1 x 8 – 12 – 20.	↑ Strength.
Butler.	1992	13 control. 12 control plus. All Male.	12 weeks.	3 x p/week.	30 mins.	8.	40%.	2 x 10.	↑ Walking Time. ↑ Strength.
Daub.	1996	15 control. 42 control plus. All Male.	12 weeks.	3 x p/week.	40 mins.	6.	20%, 40%, 60%.	2 x 20. 40. 60.	↑ Walking Time. ↑ Strength. *Upper body exercises
Stewart.	1998	11 control. 12 control plus. All Male.	10 weeks.	3 x p/week.	35 mins.	6.	40%.	2 x 10 – 15.	↑ VO_2 max. ↑ Cycle Duration. ↑ Strength.
Beniamini.	1999	16 control. 18 control plus. 9 Females.	12 weeks.	3 x p/week.	40 mins.	4.	50%. 80%.	3 x 8.	↑ Walking Time. ↑ Strength.
Adams.	1999	0 control. 61 participants. 15 Females.	8 weeks.	2 x p/week.	30 mins.	5.	60%. 80%.	2 x 8 – 12.	↑ Walking Time. ↑ Strength.
Pierson.	2001	10 control. 10 control plus. 7 Females.	6 months.	3 x p/week.	30 mins.	7.	40%.	2 x 12 – 15.	↑ Walking Time. ↑ Strength.

2.3: Cardiac Rehabilitation Programmes.

Whilst it is suggested that the benefits of physical activity in treating those with cardiac related illness existed over two centuries ago (Certo, 1985), it is not until a later time period that CRP's were being observed in the United States of America (USA) early in the 20th century (Durbin & Goldwater, 1956). The message conveyed throughout their work is that movements involving the lower limbs should be encouraged to promote physical and psychological well being. This is a recommendation that is still currently promoted in modern day CRP's. These suggested movements also fit comfortably with the present description of CV exercise recommendations.

CR has continually evolved from a time period in the 1950's, when a belief existed that physical exertion may cause a deterioration in a patients well-being if not followed with care in those who were recovering from a MI (Bethell, 1999). This view has altered through time and is evident in current day practice, where CRP's aim to have patients out of bed and moving at the earliest possible time period appropriate to the individual and their abilities (Proudfoot, Thow, & Rafferty, 2007).

Early evidence of a suggestion of the overly protective medical care offered to post-event MI patients was observed half a century ago in an early review by Balotin (1959), who discussed the concerns that existed during an initial period of bed rest for these patients. The concerns were evident as even the promotion of minimal amounts of movement required careful deliberation. The cautious treatment discussed in this study, called for the consideration of

such movements that even involved the digits of the upper limbs; but it was accepted that such movements could be permitted without causing alarm.

Having to make use of a bedpan was considered to pose a significant risk. To minimise myocardial workload, a patient was transported with caution by nursing staff when its use was required.

As the period of recovery developed, movements of the lower extremities were encouraged, with an aim to promote venous return. Further evidence of the stringent medical care is acknowledged in the practice that by the end of a fourth week of bed rest, a patient may have, if able to do so, been permitted to read and write letters.

Despite such an early emergence of CRP's in the USA, CRP's had a delayed appearance in the UK until prior to a period just before the 1990's (Fearnside, Hall, Lillie, Sutcliffe, & Barrett, 1999). In Scotland, despite it being recognised as a nation with a high prevalence of CHD in the periods 1990 - 1999 (Scottish Executive, 2001), only 69 CRP's existed in 1996 (Campbell, Grimshaw, Rawles, & Ritchie, 1996).

2.4: Exercise Programme Design.

The most commonly found frequency of session provision in the reviewed studies was three times per week (Beniamini, Rubenstein, Faigenbaum, Lichtenstein, & Crim, 1999; Butler, Palmer, & Rogers, 1992; Daub, Knapik, & Black, 1996; Kelemen et al., 1986; Pierson et al., 2001; Sparling, Cantwell, Dolan, & Niederman, 1990; Stewart et al., 1998).

Only one of the reviewed studies (Adams et al., 1999) had a different frequency to that of the others, which consisted of two sessions per week, the least amount noted in this review.

A total of 282 individuals, of which 31 (11%) were female participated across all reviewed studies. The works of Adams et al. (1999), Beniamini et al. (1999), and Pierson et al. (2001), conversely, did have 15 (nine and seven female participants respectively). Such male domination is common in research studies involving CR (Gayda, Choquet, & Ahmaidi, 2009; Levinger, Bronks, Cody, Linton, & Davie, 2005; Norrbrand, Fluckey, Pozzo, & Tesch, 2008; Sparling et al., 1990). The skewness of gender differences in such studies requires an acknowledgement, of the impact that these gender differences have on the research findings (Ogawa et al., 1992).

91 (32%) participants were deemed as being in control groups and as such, did not perform the RT component of the programmes within the reviewed studies.

A large variation in the duration periods are noted across the reviewed studies, ranging from the lowest of eight weeks (Adams et al., 1999), through to two studies having a duration of six months (Pierson et al., 2001; Sparling et al., 1990).

The programme designs varied from having a CV component of only 20 minutes (Kelemen et al., 1986), in comparison to 40 minutes (Beniamini et al., 1999; Daub et al., 1996).

The RT component of each study varied from performing four movements (Beniamini et al., 1999) to 12 movements (Sparling et al., 1990).

The studies illustrate a wide and varied range of initial preliminary weight loads across each study; from the determination of a minimum 1RM of 20%, up to a maximum of 80% of 1RM. The set and repetition range in this component varied from one to three sets with a repetition range from eight repetitions in several studies, up to 60 repetitions in the study of Daub et al. (1996).

Regardless of the research methods chosen in each study, whether it be a variation in the amount of repetitions performed, the initial lifting percentage of the 1RM, or the weekly frequency of the workout, all studies demonstrated an ability to increase both strength and CV fitness without adverse effects to participants. Such findings should encourage a degree of confidence in a healthcare professional who holds the view that RT may lead to adverse effects in their CR group.

In their research, Butler et al. (1992) used participants who had previously performed a six week CV only exercise programme prior to the commencement of their trial, and who could have developed some degree of CV fitness. The initial fitness levels of participants in such studies does require careful consideration, as those deemed to be of low fitness levels do initially make statistically greater gains in both strength and CV fitness in comparison to individuals of a higher fitness level (Kraemer et al., 2002; Meyer et al., 1997; Pollock et al., 1998).

Two studies (Daub et al., 1996; Pierson et al., 2001) were found to forgo a recommended amount of time in a warm-up and a cool-down period. In the former case, offering five minutes per component and in the latter case offering 10 minutes for the warm-up period. The current recommendations for

the warm-up and the cool-down component of a CRP exercise session are for these periods to be of 15 and 10 minutes respectively (Bell, 2006).

2.5: Rate Pressure Product.

The determination of RPP ultimately provides an indirect measurement of myocardial workload (Gobel, Norstrom, Nelson, Jorgensen, & Wang, 1978).

The earliest reviewed study (Kelemen et al., 1986) showed no significant RPP differences between each of the groups were found, nor were there any noted changes of significance pre and post each of the individual interventions. These findings point to the safety of RT in that peak RPP during this form of training does not rise to levels that may cause concern (Schmid, Adams, & Cheng, 2009).

Whilst it may be sensible to suggest that the recording of HR's via the use of a HR monitor or via palpation of a pulse at a localised site is simple for those trained to do so, the recording of BP during RT is more difficult, due in part to the moving limbs involved in the exercise.

Sparling et al. (1990) are noted as having recorded BP measurements via the method of using a sphygmomanometer and a stethoscope. These measurements were not recorded at peak times, such as when the resistance movement was being performed. The authors however did record the reading, pre, mid and following the training session. The study found that the addition of RT to a CV based exercise programme provided no detrimental effects to the participants, nor were there any significant abnormal BP responses over the whole of a six month period. Unfortunately in this study, no consideration

was given in relation to RPP with the detection or measurement of HR being nonexistent.

In contrast, Butler et al. (1992) in their study made use of telemetry for the accurate recording of HR. BP was measured using a sphygmomanometer with readings being taken as soon as an exercise movement had been completed, and thus like Sparling et al. (1990) they were unable to record the peak values that would have occurred during the RT movements. The authors found that BP measurements were found to be lower in the RT movements in comparison to the CV exercise, whereas the HR's were found to be similar.

Daub et al. (1996) present similar findings. They found that both the HR's and the BP's were found to be lower in the RT group, in comparison to the control group. However, as like the other studies the BP was measured after the movement and not during the readings, which would differ.

Stewart et al. (1998) make reference to their method of BP measurement which was recorded via the use of a sphygmomanometer, the cuff of which was secured onto an individual's upper arm to allow the reading to be measured as close to the completion of a movement as possible, but still the reading was recorded following a movement and not during one. Recording during the movement would provide a higher degree of precision with the actual BP values that had been recorded. Without the modern day advances which now allows for BP to be monitored at the wrist, methods to measure BP during activity may have been difficult to obtain.

It is important to distinguish the difference between an isometric exercise, where an exercise movement is held in a fixed state, for a sustained period, during muscular contraction, and its link to considerable rises in BP

(Fardy, 1981), and that of isotonic exercise, where muscular movement occurs during the performance of the movement; the type of exercise performed in the observed studies. An additional concern during sustained isometric exercise is, if during the movement, a forced expiration against a closed epiglottis (Valsalva maneuver) occurs, as this can ultimately reduce blood flow to the brain (McArdle, Katch, & Katch, 2007).

2.6: Cardiac Rehabilitation and Resistance Training Exercise.

Circuit exercise training is the commonly found form of physical activity provision provided in the East Lancashire CR service which the local RBH CRP belongs to.

One of the earliest studies which recorded circuit training programmes which included RT and CV exercise together in an exercise routine is presented in the early work of Kelemen et al. (1986). The authors set an initial load to be lifted at 40% of an individual's one repetition maximum (1RM). This percentage is matched in the majority of the reviewed studies. The theory is that this initial workload accentuates the teaching and performance of correct lifting technique, proper breathing technique and offers a resistance that individuals would not find difficult, initially to lift. The 1RM did increase for each individual on the majority of the resistance machines over the length of this study. It is necessary to emphasise the significance of an initial 1RM workload of 40%, in being able to demonstrate significant strength increases of 24% on average in the study. The individuals from the RT and CV group illustrated a greater programme adherence rate (81%) in comparison to the control group

(66%), promoting another positive viewpoint for the promotion of RT within a CRP.

Sparling et al. (1990), investigated the effect that participation in RT exercises combined with a CV exercise programme would have on BP. Resembling the work of the previous authors, based on 30% to 40% of a predicted 1RM, an increase in personal strength was found. The study found that the addition of RT to a CV based exercise programme provided no detrimental effects to the participants, nor were there any significant abnormal BP responses over the six month study period.

Further support of the safety and benefit of including RT in a CRP is provided in the work of Butler et al. (1992) who designed a study which carried out upper body only RT, combined with CV exercise, in comparison to a CV exercise only group. The RT was performed over eight exercises, a total of two sets of 10 repetitions. This method, of requiring a singular amount of repetitions, would allow a specific comparison to be made in the strength gains of that individual when for example an increased amount of weight was being used for the same amount of repetitions. Similar to the previous two studies, a 40% of 1RM workload was the initial load for the movement.

Three further studies also offer support to the benefits to be gained from the participation in RT. Firstly, providing further evidence of the safety of involving the upper limbs in RT is observed in the study of, Daub et al. (1996) who together with a CV exercise programme, performed six upper body resistance exercises, over two circuits. Post-event MI patients were randomised into one of four groups, of which three involved a combination of RT at either 20% of 1RM for 20 repetitions; 40% of 1RM for 10 repetitions, or

60% of 1RM for seven repetitions, in addition to CV exercise. All three RT groups showed an increase in strength gains. Secondly, Beniamini et al. (1999) in their RCT, found many positive gains were observed by the addition of a RT programme. This study utilised two upper body exercises and two lower body exercises. Thirdly Pierson et al. (2001) in their work had a RT group performing two sets of between 12 - 15 repetitions on seven different resistance exercise machines. The CV exercise period was for 10 minutes on three pieces of equipment. Results from this study indicate strength gains for all participants with the combined training group making the greater gains.

Two studies involving individuals, considered as high risk patients, encountered no untoward events. In their work Stewart et al. (1998) involved patients, less than six weeks post-event. The patients were randomised either into a RT programme with cycling, or a cycling only group. The authors found that the combined RT and cycling group demonstrated an increase in both strength gains and in CV fitness. In comparison to the cycling group who did not improve their strength levels, which would have been expected. This study took place over a decade ago, such a programme design today would still cause a degree of alarm in the local CRP and would in all likelihood be forbidden due to local protocols. The authors deserve praise for their boldness to undertake such a programme design.

In a second study, Adams et al. (1999) included patients with an ejection fraction of 10 to 30 per cent, and who varied in their cardiac conditions. Unfortunately no control group existed, preventing a comparison of performances to be made across the sample. It is acknowledged that emergency teams were at hand in the facility of the study, and were fully

aware of the ongoing study. The group performed two sets of five exercises, twice per week on two non consecutive days. During week's three to eight, the intensity increased from 60%, to 80% of 1RM. An incremental CV exercise programme, consisting of 15 minutes walking and 15 minutes cycling was performed prior to each RT session and in addition, was performed on one other day per week that did not include RT. Those who completed the programme increased their strength and walking duration. Similar to the previous study of Stewart et al. (1998), the fact that the latter authors were prepared to work with such a high risk group, regardless of the low ejection fraction of the participants deserves praise. The fact that improvements were observed in such a group should not appear as a surprise considering the earlier statement that those of a lower initial fitness level can make significant gains.

2.7: Psychological Well Being.

The HADS test (Zigmond & Snaith, 1983), is not solely confined to use in a hospital setting (Snaith, 2003; Wilkinson & Barczak, 1988); it is used as a screening tool nationally and locally in PCT's (Wilkinson & Barczak, 1988). The test consists of 14 questions (seven each for the anxiety and the depression factors). The questions are alternatively asked from each independent factor, and are completed within a short period of time (Clark & Fallowfield, 1986; Snaith, 2003), with a participant asked to choose from one of four potential responses per question. The scoring range for each question is, zero – three, thus giving a potential score for the anxiety factor of zero –

21, and likewise for the depression factor. Changes greater or less than two are of clinical significance for either of the factors (Zigmond & Snaith, 1983). Scores of greater than eight are deemed to be of significant risk, and scores of greater than 11 are deemed to be clinically significant (Bambauer et al., 2005; Zigmond & Snaith, 1983).

The HADS test is considered favourable to other psychological well being tests, due its ease of completion, and its ability to be utilised without specific training (Wilkinson & Barczak, 1988).

UK guidelines suggest that the timing of the HADS test should not be prior to six weeks post-event, but no later than 12 weeks post-event, and that when necessary the test should be repeated 12 weeks later (Scottish Intercollegiate Guidelines Network (SIGN), 2002). This period of times ensures that exceptional events are not impacting detrimentally on the recorded scores.

Contradicting this guideline is the evidence of the high levels of anxiety and depression that do occur in individuals who present with chest pains to an emergency hospital setting and the use of the HADS tool in such a setting (Soares-Filho et al., 2009). Whilst in such circumstances there is a need to rule out chest pain, due to a potential myocardial infarction, and not merely high levels of anxiety, it is understandable that health care professionals do try to discover individual states of anxiety. The sooner such states are recognised, the sooner the specific needs of an individual can be addressed.

There is also a financial element to consider in regards to identifying anxiety levels. Individuals who are identified with high levels of anxiety, and

who are appropriately identified, may not require the emergency medical care that is initially instigated, which may allow for a monetary saving.

The HADS test has been introduced to non-English speaking populations and has managed to retain its validity as a tool to screen for anxiety and depression levels within a population (Herrero et al., 2003; Michopoulos et al., 2008; Montazeri, Vahdaninia, Ebrahimi, & Jarvandi, 2003).

The HADS tool is not restricted to a singular patient group; much work exists in the application of this screening tool across many diseases (Bambauer et al., 2005; Castelli, Binaschi, Caldera & Torta, 2009; Dowson et al., 2001; Woolrich, Kennedy, & Tasiemski, 2006), highlighting the specificity of the test, and its strength to work in many areas of medical care (Mykletun, Stordal, & Dahl, 2001). However it has been suggested that the test is not suitable during a period of pregnancy (Karimova & Martin, 2003).

There are a host of reasons as to why individuals do not wish to participate in CRP's, which can include the level of anxiety and or depression that the individual is suffering (Yohannes, Yalfani, Doherty, & Bundy, 2007). The sooner these reasons can be identified, through such tools as the HADS test, the earlier an individual can begin to recover from such illness (Worcester & Le Grande, 2008).

2.8: Conclusion.

Despite the success of the studies involving RT, there still remains a partiality of neglecting strength gains in favour of CV gains in CRP's. Reasons such as a lack of skill and / or experience in the delivery of RT by multi

disciplinary teams may perhaps determine such choice of physical activity. Perhaps a factor is the time required to work closely with individuals, and its impact on workload within the multi disciplinary teams.

This research study will address all of these potential reasons by the promotion of its findings.

This review has highlighted the many factors that require addressing in relation to developing both strength and CV fitness. These include the determination of the initial percentage of a RM and the number of repetitions to move that weight.

From experience, it has been found that individuals who have a choice to make in relation to the number of repetitions are often confused as to which actual number of repetitions to perform. The study will have the participants perform exactly 10 repetitions. Consideration of the RM has been given to my planned study, with safety of paramount importance. Hence participants will commence with a weight load 50% of their 10 RM test. This percentage has been highlighted in this review to be successful in beginning a RT exercise programme, with the aim of increasing strength levels.

None of the reviewed studies make reference to the psychological benefits of participating in a CRP. My study will aim to measure anxiety and depression levels pre and post-intervention.

The duration and frequency of the reviewed studies have a large range. My study will have an exact duration of six weeks, which presently matches the hospital based phase three sessions, and will offer RT on one session per week, a period of time not performed in the reviewed studies.

No use has been referred to in any of the reviewed studies in relation to the 10m ISWT as a measure of functional capacity, this research study shall. The 10m ISWT shall be performed pre and post-intervention to assess for changes in functional capacity. BP and HR shall be recorded at both the pre and post-intervention consultations.

Chapter 3. Method.

3.1: Introduction.

This study compared the data recorded from a 10m ISWT; the RPP, along with the anxiety and depression levels of two separate populations.

Differences which may be found in the two randomised groups of post-event MI patients were analysed within each group, and across both groups.

3.2: Ethics.

Ethical clearance for this research study was granted by the University of Chester Ethics Committee (Appendix E). As part of the ethics application a flow chart was designed to clarify the research pathway (Appendix F). An approved informed consent form (Appendix G), was signed by all participants prior to participation in the study.

3.3: Participants.

All participants had previously completed the phase three CRP at RBH and were referred from the CR medical team, into the current BwDBC phase four CRP. This phase four programme is delivered across five sites across the localities of Blackburn and Darwen.

Senior management were consulted prior to determining which of the five venues would be used for the research study. It was agreed that Darwen

Vale Regency Gym (DVRG) would be the preferred venue to deliver the study. This venue hosts a long established CRP which the referred, former patients became part of. Rather than having a separate stand alone, research specific programme for the participants, it was determined that all would benefit by sharing the same experiences and camaraderie of the other existing CR participants by participating alongside them. Thus the research study was integrated within the existing CRP. The CR sessions were delivered on a Monday, from 11.00 to 13.00 hours.

Safety is of paramount importance during all phase four sessions. On site was the researcher who is qualified in Intermediate Life Support (ILS) and in the use of an Automated External Defibrillation (AED). Also present in the DVRG facility were three First Aid trained members of staff who are also AED qualified. An AED machine, (Philips, Heartstart FR2, Amsterdam, Netherland) is present on the facility at all times The studio area and the gym area are both air conditioned, and have cooled water freely available. A telephone is alongside both areas for use should an emergency situation arise.

Upon receipt of the referral form from the phase three CRP, the researcher contacted the former patients by telephone to enquire with regards to their chosen venue for participation in the community based phase four CRP. If DVRG was not the preferred venue for attendance, or if the participant referred had no recent history of myocardial infarction, then normal operating procedures of the CRP were adhered to. If the DVRG was their venue of choice, then they were verbally given an offer to participate in the research programme, which all of those who were offered did accept. Each participant was then invited to attend an initial consultation to discuss the research

programme. All participants were given a copy of the participant's information sheet (Appendix H) to read. All participants who attended the initial consultation expressed a desire to fully participate in the research programme once this document had been read and the implications of participating in the study had been explained and understood.

Referrals made into the whole of the BwDBC CRP have averaged approximately 85 referrals per year, over the past six years, across varied districts in the locality. The recruitment of those referred specifically to a singular, specific site, raised concerns into the possible low referral numbers that would become available to take part in the study. Whilst the numbers received were rather low, due to the enthusiasm, and the uptake of those who were referred to DVRG, the numbers taking part in the study were actually higher than anticipated during the recruitment duration of the study. The 18 participants who were selected and completed the study were recruited during an 11 month period beginning July 2008, until May 2009.

3.4: Inclusion Criteria.

The inclusion criteria for the research programme, was for those being referred to either (a) be residents of BwDBC, or (b) be registered with a BwDBC General Practitioner (GP). Males and females who were to be referred, and who accepted an invitation to participate, were required to have completed their medical treatment following an initial primary diagnosis of having had a myocardial infarction. All were discharged from the phase three CRP, in a clinically stable condition and were not awaiting any further

investigation or treatment. The participants were risk stratified by the medical team and were stratified as being low to moderate risk (Appendix I). Risk stratification was also carried out during the consultation appointment as per agreed standards (Whaley, Brubaker, Otto, & Armstrong, 2006).

3.5: Exclusion Criteria.

As per the agreed guidelines (BACR, 2007), in relation to referrals received from the phase three CRP to the phase four CRP, the following exclusion criteria applied to those who were referred; unstable angina, acute heart failure, unstable diabetes, uncontrolled arrhythmia, a resting HR greater than 100 beats per minute (bpm), a SBP greater than 180 mmHg, a diastolic blood pressure reading greater than 100 mmHg, hypotension and when noted, a febrile illness (upon attendance at the session).

3.6: Randomisation.

Referred participants were randomly assigned into either a combined exercise training programme which included RT in conjunction with a CV exercise programme, or a CV exercise only programme, by a World Wide Web based programme (Appendix J).

3.7: Medication.

Medications were recorded at the start of the study to allow for changes in the type, or the amounts of the medically prescribed medications that were being taken by a participant, throughout their six week duration in the study, to be noted.

3.8: Initial Consultation.

At the initial consultation, all participants were given a facility orientation to the layout of the DVRG. Following this, the participant read through the associated paperwork. This paperwork consisted of the participant information sheet, which was retained by the participant. A consent sheet that required signing by the participant, a copy of this document was retained by the participant. A home based, physical activity recording sheet was issued to allow the recording of physical activity participation on five days of each week throughout the study. An advice sheet detailing the delayed onset of muscle soreness (DOMS), and the recommended treatment advice, was retained by the participant (Appendix K). Documents that were retained by the researcher were; the SC training record (Appendix L) and the SCP training record (Appendix M). These record sheets recorded the many details of the participant's performance during their attendance at each session.

In consideration of a possible inability to estimate exercising HR as has been found in studies involving CRP participants (Kollenbaum, 1994), various methods of intensity monitoring were discussed and explained to each

participant. This verbal advice was supported by a document (Appendix N), informing the participants of the varied ways of ensuring that a suitable intensity could be measured during their physical activities (Borg, 1998).

Documents retained by the researcher were; the actual referral form received from the phase three programme, and a supporting exercise training record from the hospital based phase three programme. A self screening questionnaire to assess the psychological status of the participant was utilised, which was the HADS. This was completed prior to the 10m ISWT; the 10m ISWT recording document, which detailed walking distance and speed, pre and post-test BP and HR.

3.9: Functional Capacity Testing.

The participants had their BP and HR's recorded (Omron Healthcare, HEM-907, Kyoto, Japan). All readings for BP recordings were recorded on the left upper arm.

During the 10m ISWT, each participant wore a wireless HR transmitter and receiver (Polar Electro, F55, Kempele, Finland) and were asked to call out the reading that was being displayed on the receiver at the end of each minute.

Each participant had previously carried out the 10m ISWT, prior to the commencement of their phase three CRP and thus were familiar with the protocol and what to expect during the test. The test consists of two cones, placed nine metres apart, with space allowing for a half metre turning arc at each end, providing an actual walking distance of 10 metres. The participant

was required to keep pace with the high pitched tones that were emitted from a compact disc that was being played. As the duration of the test increased, then so did the required walking speeds of the participant. When the participant was unable to maintain the required walking speed, coinciding with the high pitched tones, the test was terminated and they were asked to walk slowly around the studio for a period of one minute. This was followed by one minute of being seated with gentle toe tapping, prior to having their post-exercise BP and HR's recorded. Results of the walking test were provided to the participant in a reflective discussion. Participants were asked to confirm how they perceived their effort during the walking test, with the aim of having the participant relate to these feelings during other physical activities. Feedback also allowed the participant to note their final walking speed and how this speed could be transferred on to the treadmill and other equipment to be used in their CV exercise programme.

3.10: 10 Repetition Maximum (10 RM) Testing.

Following the completion of the studio based 10m ISWT, the participant moved into the gym area to perform a 10 RM test. The participant observed a demonstration by the researcher as he performed on each of three pieces of equipment.

It was intended to discover the 10 RM of each participant within two sets of the participant performing the movement. This was achieved by the participant performing two repetitions of a weight load, estimated by the researcher. Depending on the degree of effort required to lift the weight, the

weight was adjusted and a further two repetitions were completed, if necessary this was completed a third time. From these repetitions a 10 RM starting weight was agreed with the participant. Following the determination of the starting weight, and a rest period of five minutes, the participant performed one set of 10 repetitions of a weight load, agreed to be the participants 10 RM. The 10 RM was recorded on each of the three RT exercises that were performed by the combined training group. This weight was then reduced by 50%, and was chosen as the starting weight, in week one of the research study. The weight load was increased on a weekly basis, ultimately achieving by week five, the same 10 RM as determined during week one. On week six, the final week of the study, the participant aimed to set a new 10 RM. This involved choosing the next weight block up from the one that had achieved the previous 10 RM. In the case of the leg press this was a 10 kilogram (Kg) block. In the high pulley and in the chest press this was a five Kg block.

The RT exercises were performed in the following order, (1) on a lying leg press, to target the musculature of the lower body; this entailed the upper body being fully supported with the head relaxed. Feet placed slightly wider than hip width apart, ankle joints in line with knee joints, which were in line with hip joints, creating a 90^0 starting angle; (2) a high pulley pull-down, involving the feet being placed flat on the floor and the upper thighs supported below a thigh brace. Participants took hold of the bar, palms of hands facing away from the body and slightly wider than shoulder width apart, targeting the musculature of the back area, the biceps and the forearms, and (3) a lying chest press, where the participants upper body and head were supported on an incline bench, feet were flat on the floor, palms facing away from the body,

which targeted the musculature of the chest, shoulders and triceps areas. The order that the equipment was utilised during the 10 RM testing was used during the RT component of the combined groups exercise programme.

3.11: Exercise Protocol.

The CV element for each group consisted of a total of 30 minutes (10 minutes duration on three pieces of equipment). CV equipment utilised was a treadmill (StarTrac, S - TR, Irvine, CA, USA), a stationary cycle (StarTrac, S – UB, Irvine, CA, USA) and a rowing ergometer (Concept 2, Model D, Morrisville, VT, USA).

Due to capacity issues within the session it was not always possible for the participants to perform the same CV machines in the exact, same order, however the participants were still restricted to utilising the previously named equipment.

All participants were instructed on how to use the CV equipment. On average by the third session each participant required little assistance in setting up or making adjustments to the equipment. Aside from the concept two rowing ergometer, which was prepared with a vent setting of level four, for all participants, (in the knowledge that the intensity of the exercise could be determined by altering the amount of pull applied to the rower handle); the maximum walking speed on the treadmill was controlled by the participants, as was the level of resistance on the stationary cycle. On the cycle, all participants aimed to maintain a cadence of 60 - 70 revolutions per minute (RPM). The intensity of effort was monitored by the researcher using a talk

test, ensuring that each participant could hold a conversation during their activity. The talk test was reinforced using the Borg rating of perceived exertion (RPE) scale (Borg, 1998) at a level of 12 to 13 (“somewhat hard”). All participants had previous experience of the RPE scale, through its use during their hospital based phase three CRP. Consideration was giving into the potential use of the Borg category ratio (CR 10) scale, due to its potential to be used in CV and RT exercise programmes (Day, McGuigan, Bryce, & Foster, 2004). However due to the previous understanding of the RPE scale gained by the participants, it was felt that this may lead to a degree of confusion in the participants.

As not all participants may be able to relate HR intensity to their perceived exertion initially (Kosiek, Szymanski, Lox, Kelley, & Macfarlane, 1999), all participants were provided with the guidelines for using the scale to enhance their knowledge (Appendix O). Upon completion of the CV component for the CV only exercise group, a period of slow walking and light stretching for 10 minutes around the gym area was carried out. Following this period each participant had their BP and their HR’s recorded as part of a cool-down period to ensure each participant had returned to near pre-exercise levels.

RT was performed for one set only, for 10 repetitions on the leg press, high pulley and incline chest press (StarTrac, Impact, Irvine, CA, USA). These RT movements were performed following the 30 min CV exercise programme for those randomised into the combined training SCP group.

A period of two minutes rest was provided, which included the time period involved in transferring from machine to machine, and the preparation

period so as to be ready to begin the next movement, on the next piece of equipment. The participants were instructed on the safe lifting technique of each movement, ensuring that exhalation was being done during the most difficult part of the movement. This technique ensured that participants were not forcefully exhaling against a closed epiglottis. Where confusion arose, participants were asked to count aloud each repetition as it was being performed. HR was not assumed to be indicative of the intensity that each participant exercised at, as the rise during the movement is not consistent with oxygen consumption (Whaley, Brubaker, Otto, & Armstrong, 2006). Following the completion of the RT, the participants carried out the same cool-down protocol as those in the CV exercise only group.

3.12: Post-study Consultation.

Adherence rates for all participants were 100%. No issues (muscle soreness, other injuries or cardiac related events) relating to the participants health and well being were encountered. Following the completion of the six week study for each participant, a follow on consultation was arranged. At this consultation the participant was seated for 15 minutes prior to having their BP and HR measured. During this period the participant completed a programme evaluation form (Appendix P). A repeat of the initial consultation took place in regards to the protocol that was followed for the 10m ISWT.

BP and HR were again measured following the one minute slow walk and a one minute seated recovery. Participants were informed that following a

detailed analysis of their unique results, they would receive a written report (Appendix Q) and a copy of their completed training record.

3.13: Statistical Analysis.

All primary data for analysis was collected by myself. All data was from randomly selected group participants. Data was investigated to ensure assumptions of normality ($p > 0.05$) using the Shapiro-Wilk test, utilised due to the total number of participants being below 100 (Coakes & Steed, 2003). Data was required to pass an assumption of homogeneity of the variance ($p > 0.05$), and were parametric. This allowed an initial dependent t test to be carried out to investigate differences within each group and secondly an independent t test to investigate differences between the groups.

The Levene's test for equality of variances was used to confirm that there was no statistically significant difference between the groups (which were unequal in size) variables.

When an assumption had been violated, the appropriate non-parametric test took place; either the Wilcoxon Signed Ranks Test or the Mann-Whitney U Test.

When a test for significance was carried out the data was investigated at a probability error of less than 5% ($p < 0.05$).

Functional capacity data measurements from the 10m ISWT were recorded pre and post-intervention. A comparison was then made between the initial 10m ISWT performance scores and subsequent 10m ISWT

performance scores following the programme, to indicate if significant changes had occurred.

The data was checked for a normal distribution. A parametric t–test was used to test for differences in these measures.

A comparison of the pre-study HADS and the post-study HADS using a Wilcoxon Signed Ranks Test was utilised for the depression variable due to it having failed the assumption test of normality ($p > 0.05$). This would have highlighted any significance in the psychological status of participants upon conclusion of the study.

A further non parametric test; the Mann-Whitney U Test was performed to highlight any significance in the difference of the depression variables which had also failed the test for normality in an independent t-test.

Data from pre and post-RPP measurements were checked for a normal distribution. The appropriate parametric t-test was undertaken to highlight any significant or non significant changes in the pre and post-intervention results.

Data collected from the strength tests pre and post-intervention was investigated for any differences and the significances of these changes.

Chapter 4. Results.

4.1: Introduction.

This chapter details the results that were recorded from the participants; commencing with the initial findings at baseline, recorded during an initial pre-intervention consultation, and the subsequent findings following a specific six week intervention in two unique groups, (SC or SCP), at a post-intervention consultation.

The section begins by investigating the findings from each of the individual groups at both consultations, for each of the parameters. This provides an overview of the findings prior to statistical analysis of the data using the Statistical Package for the Social Sciences (SPSS, version 16.0) software.

4.2: Participants Age.

The study recruited 18 participants during a recruitment period of 11 months, (15 males, 61 ± 6.6 years, (range 45 – 72 years), and three females (51 ± 8.8 years, range 43 – 63 years).

Cumulatively, the 18 participants were found to have similar age range findings (60 ± 8.1years, range 43 – 72 years).

The age differences between the groups were; SC group 63 ± 4.93 years, (range 55 – 72 years); with the SCP group 57 ± 9.96 years, (range 43 – 68 years).

4.3: Participant Gender.

The 15 males (83%) who were referred into the DVRG phase four CRP sessions were numerically greater than those of the female gender which numbered three (17%). This common finding is illustrated in the majority of the reviewed studies, as previously observed in chapter two.

Following the random assignment of the participants, it was found that the SCP group contained eight males and two females (56% of total participants). The SC group contained seven males and one female (44% of total participants).

4.4: Prescribed Medications.

The most commonly prescribed medication (table two) amongst the participants (cumulative amount of 82 medications) was a Statin, prescribed to all 18 participants. The other most commonly prescribed drugs to the participants were; Aspirin, Angiotensin Converting Enzyme (ACE) Inhibitor and a Beta Blocker, taken by 17 (94%), 14 (78%) and 13 (72%) participants respectively. The least commonly prescribed medication was Warfarin, prescribed to one participant.

Medications being prescribed to the SC group had a mean of four ± 1.55 (range three – 7), in comparison to the SCP group who were prescribed a mean of five medications ± 0.87 (range three – 6).

When both the SC and the SCP group were jointly considered, they had a mean of five (range three – 7) medications.

There was no change in the number, or type of prescribed medication in either group throughout the duration of the study.

Table 2. Types of Prescribed Medications.

	Participant Number																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Medication Type																			**Tot**
Statin	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**18**
Aspirin	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	**17**
ACE	1	1	1	1	1	1	1	1	1		1		1	1	1			1	**14**
B Blocker	1		1	1		1	1		1	1		1	1	1		1	1	1	**13**
GTN			1			1	1	1						1	1				**6**
Calcium CB		1		1				1	1										**4**
Clopidogrel								1	1				1						**3**
Angio II Rec								1								1			**2**
Diuretic		1		1															**2**
Proton PI													1					1	**2**
Warfarin		1																	**1**
	4	**6**	**5**	**5**	**3**	**5**	**5**	**7**	**6**	**3**	**3**	**3**	**6**	**5**	**4**	**4**	**3**	**5**	
Medications per person																			

Number of Medications

4.5: Pre and Post-Intervention Consultation findings.

Prior to the specific statistical analysis of all gathered data, the following data, collected during the pre and post-intervention consultation for each participant is discussed to provide an outline of the overall results.

4.5.1: Mean 10m ISWT Results.

Comparisons of the pre and post-intervention results (figure three) demonstrate in the pre-intervention 10m ISWT, that the SC group recorded a

mean walking distance of 414 ± 130.6m, (range 300m - 690m). Following the six week intervention, the SC group demonstrated a 46.9% increase in their mean 10m ISWT walking distance, increasing their previous mean walking distance by 194 to 608 ± 201m, (range 350m - 960m).

A significant difference was found, p = 0.09 (two tailed), between the pre and post-intervention walking distances, 194 ± 154.6m, with an observed 95% confidence interval (CI) (ranging from 64.47 to 323.03).

In comparison, the SCP group walked a mean distance prior to the intervention of 512 ± 110.33m (range 370m - 670m). The SCP group following the intervention increased their mean walking distance 31.3%, from their previous mean distance to 672 ± 171.52m (range 420m - 920m). Significant differences were noted in the pre and post-intervention walking distance, 160 ± 104.24m, p = 0.001, two tailed. The CI ranged from 85.43 to 234.57.

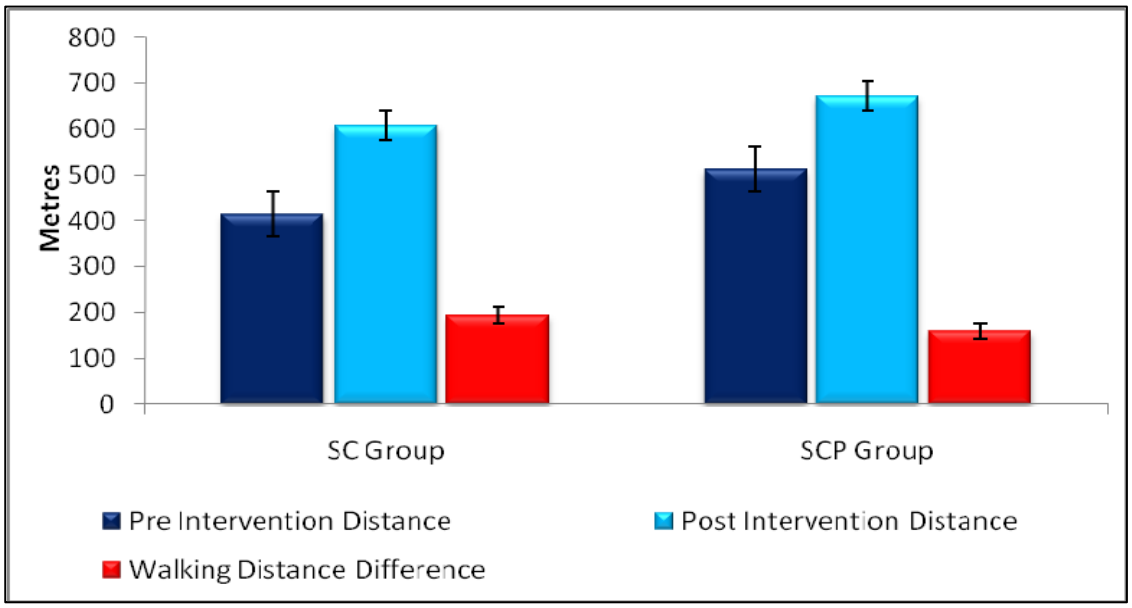

Figure 3. Mean 10m ISWT performances pre / post-intervention.

An independent t-test was performed which demonstrates no significant mean 10m ISWT differences between the SC group, or the SCP group at pre-intervention (p = 0.10) or post-intervention (p = 0.47).

A further independent t-test was performed, investigating the mean cumulative differences from the pre and post-intervention calculated data (table three). The table evidences a non significant mean walking difference between the groups of 34m, CI: - 95.71 to 163.21.

Table 3. 10m ISWT Independent t test result.

group	mean pre / post intervention walking distance difference	Standard Deviation ±	Confidence Interval	P Value
SC	194m	154.64	64.47 - 323.03	0.59
SCP	160m	104.24	85.43 - 234.57	

4.5.2: Mean RPP Results.

Comparisons of the pre and post-intervention RPP results (figure four) demonstrate that the RPP for the SC group pre-intervention, was recorded as having a mean RPP of 84 ± 15.24 mmHg.bpm (range 57 - 104); The mean RPP recorded following the intervention for the SC group, demonstrated a decrease of six mmHg.bpm (7.1%) to 78 ± 13.04 mmHg.bpm (range 64 - 101). The RPP difference is noted as not being statistically significant, 5.88 ± 8.08 mmHg.bpm, p = 0.79, CI: - 12.63 to 0.88.

The pre-intervention RPP of the SCP group had a mean of 82 ± 18.88 mmHg.bpm (range 44 - 112). The mean RPP following the intervention of the SCP group was decreased by 2.4%, to 80 ± 14.36 mmHg.bpm, (range 54 - 100). This data is noted as showing no significance (p = 0.66). The CI ranged from, -12.56 to 8.36 for RPP.

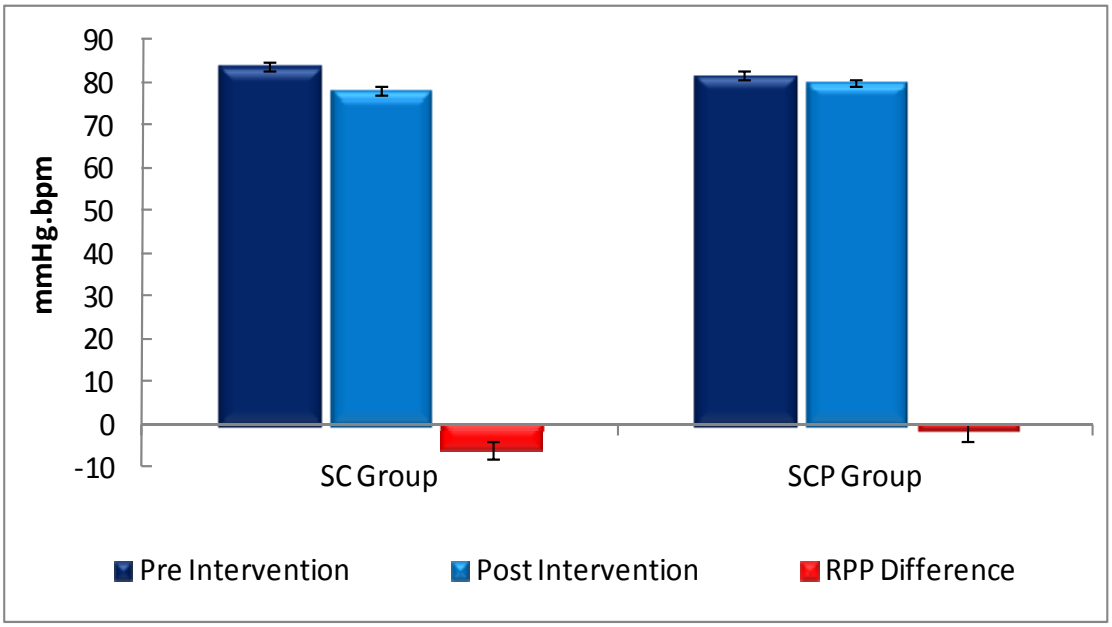

Figure 4. Mean RPP pre / post-intervention comparisons.

When the data of each group is compared in an independent t-test, it was found that no statistically significant differences existed; RPP pre-intervention p = 0.87, CI: -16.08 to 18.88; RPP post-intervention p = 0.72, CI: - 16.25 to 11.50.

An independent t-test performed on the mean cumulative RPP differences pre and post-intervention between the groups demonstrates no significance between the groups (table four). The table illustrates a mean RPP difference of - 3.78 mmHg.bpm, CI: - 16.04 to 8.49.

Table 4. RPP independent t test result.

group	mean pre / post RPP (mmHg.bpm) difference	Standard Deviation ±	Confidence Interval	P Value
SC	-5.88	8.08	- 12.63 to 0.88	0.52
SCP	-2.10	14.63	- 12.56 to 8.36	

4.5.3: Mean HADS Results.

The mean anxiety (figure five) and mean depression levels (figure six) recorded at pre / post-intervention consultations are illustrated.

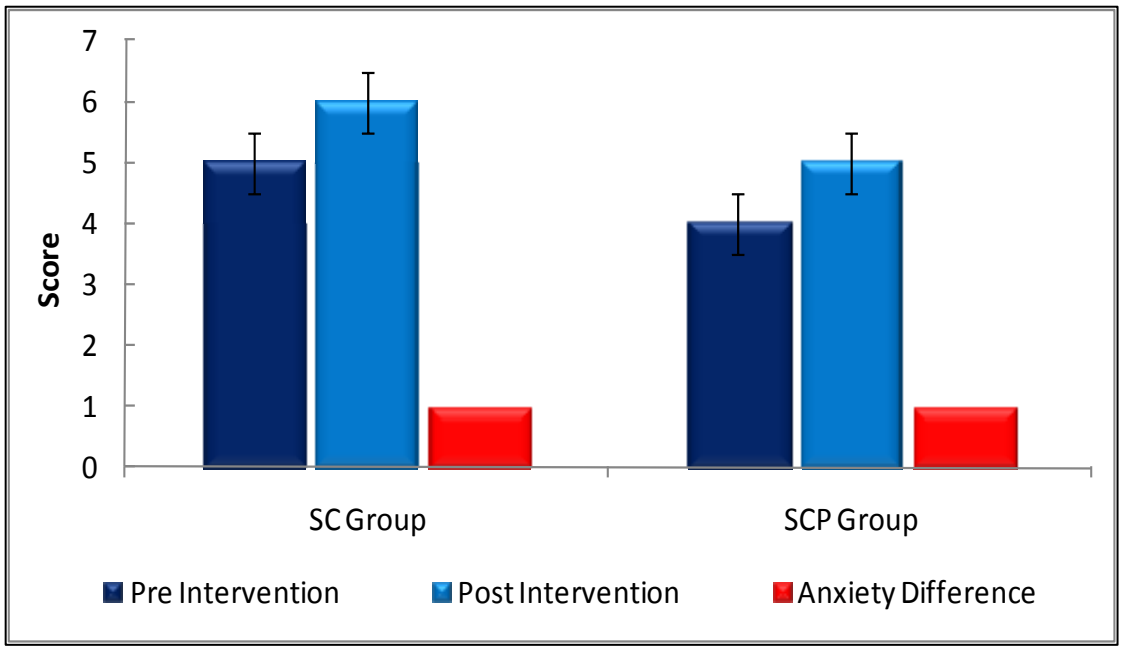

Figure 5. Mean Anxiety level score pre / post-intervention.

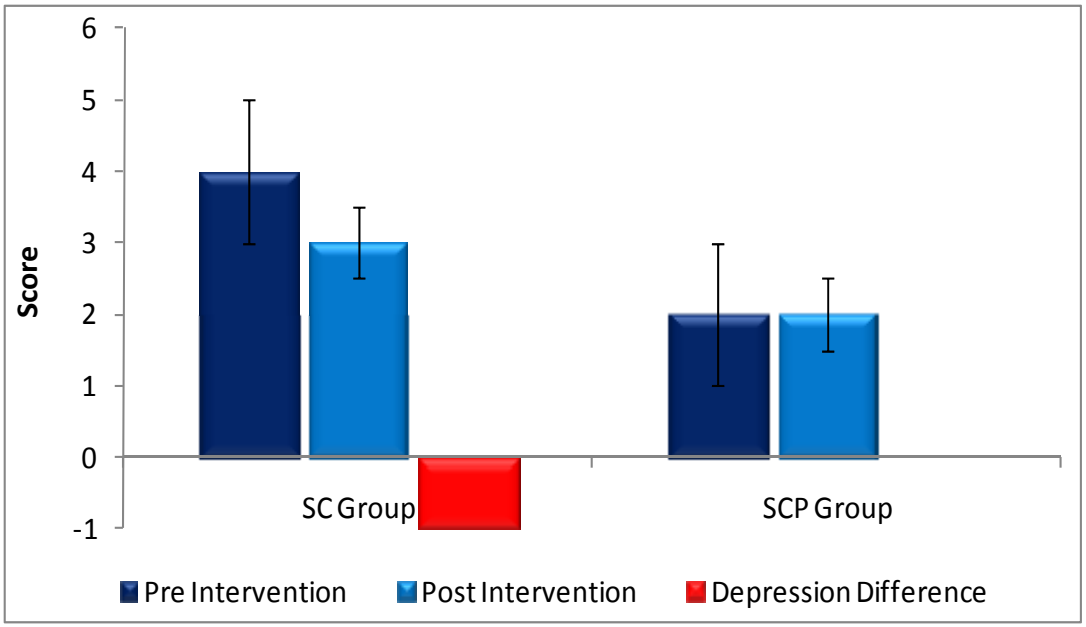

Figure 6. Mean Depression level score pre / post-intervention.

The SC group evidence a mean anxiety score of five ± 3.66, (range one - 11), and a mean depression score of four ± 3.41 (range zero - 11) at pre-intervention. Two individuals had an anxiety score greater than eight and one individual was recorded with a depression score greater than eight.

Following the intervention; the SC group had a mean anxiety score of six ± 3.48, an increment of one (range two – 12), and a mean depression score of three ± 3.54, a decrease of one (range one – 11). Three individuals had an anxiety score greater than eight and one individual had a depression score greater than eight.

Following a dependent t-test the pre and post-intervention anxiety scores are noted as showing no significance, $p = 0.41$, CI: -1.89 to 4.14.

In the depression score data for the SC group following the intervention, the collected data failed an assumption of normality, ($p = 0.01$).

The non parametric, Wilcoxon Signed Rank Test was subsequently carried out. The test highlighted a non significant difference ($p = 0.33$) in the data for depression.

The SCP group was recorded as having a mean anxiety score of four ± 3.33 (range from one to 11), and a mean depression score of two ± 1.93 (range zero - 6) pre-intervention. One individual was identified as having an anxiety score greater than eight; one individual presented with a depression score greater than eight. Following the intervention the SCP group recorded a mean anxiety score of five ± 3.24, an increase of one from the pre-intervention data (range one – 11), and a mean depression score of two ± 2.67, similar to the previous measurement at pre-intervention for this variable (range zero – 8). Two individuals had an anxiety score greater than eight and one individual was recorded with a depression score greater than eight.

A dependent t-test was carried out on the data for the pre and post-intervention anxiety variables and is noted as showing no significance ($p = 0.40$). The CI ranged from, -0.77 to 1.77.

The depression data ($p = 0.01$) of the SCP group in the pre and post-intervention failed an assumption test of normality and required an analysis of the data to be made via the non parametric test Wilcoxon Rank Test. The test highlighted a non significant difference ($p = 0.79$) following the intervention.

An independent t-test comparing the anxiety differences showed no significant differences between the SC group and the SCP group.

A Mann-Whitney U Test was carried out on the depression variables for each group which had failed the test of normality in the previous data analysis

test. The test demonstrates no significance in the difference of the depression variables, between the SC group, and the SCP group (p = 0.08), pre-intervention; nor post-intervention (p = 0.16).

A further independent t-test, investigating the mean cumulative differences from the pre and post-intervention calculated data in the anxiety variables illustrates no significant mean difference; CI: -2.122 to 3.37 (table five) and in the depression variables of each group there was again no significant difference; CI: -1.48 to 0.93 (table six).

Table 5. Anxiety independent t test result.

group	mean pre / post Anxiety difference	Standard Deviation ±	Confidence Interval	P Value
SC	1.13	3.60	- 1.89 to 4.14	
				0.63
SCP	0.50	1.78	- 0.77 to 1.77	

Table 6. Depression independent t test result.

group	mean pre / post Depression difference	Standard Deviation ±	Confidence Interval	P Value
SC	-0.38	1.18	- 1.37 to 0.62	
				0.63
SCP	-0.10	1.19	- 0.96 to 0.76	

4.5.4: SCP group Strength.

Data collected from the 10 RM tests at pre and post-intervention periods (figure 7) demonstrate the mean weight lifted in the leg press exercise was 77 ± 15.67kg (range 60kg – 100kg); in the chest press exercise, the mean weight lifted was 26kg (range 20kg – 35kg), and in the high pulley exercise, the mean weight lifted was 32 ± 6.48 kg (range 23kg – 42kg).

In the 10 RM tests following the intervention, the mean weight lifted in the leg press was 89 ± 15.95kg, an increase of 12kg (12.7%) (range 70kg – 110kg); in the chest press the mean weight lifted was 30.5kg, an increase of 4.5kg (15%), (range 25kg – 35kg). In the high pulley exercise, the mean weight lifted was 39 ± 5.95 kg an increase of 7kg (22%), (range 28kg – 49kg).

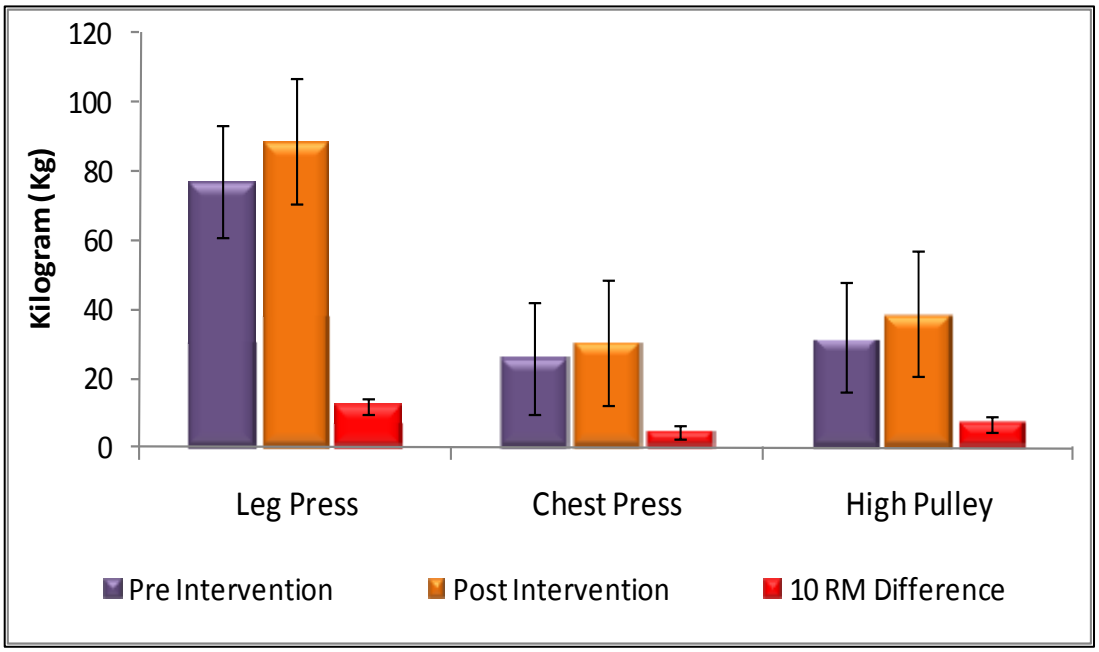

Figure 7. Mean 10 RM weight lifted pre / post-intervention.

Data collected from the SCP group following the intervention met the assumption test of normality in leg strength and in back strength. The chest press data ($p = 0.02$) following the intervention, failed an assumption test of normality and required an analysis of the data to be made via the non parametric Wilcoxon Rank Test.

A parametric, dependent t-test was carried out on the variables; leg strength and back strength. There was a significant difference found in the leg strength from pre-intervention to post-intervention, 12 ± 4.22kg, ($p = 0.001$). The CI ranged from 8.98 to 15.02.

A significant difference was found in back strength from pre-intervention to post-intervention 7.0 ± 3.36kg, ($p = 0.001$). The CI ranged from 4.40 to 9.20.

The non parametric, Wilcoxon Signed Ranks Test was carried out on the chest strength variable. The test highlighted a significant difference in pre and post-intervention chest strength ($p = 0.007$).

No feedback of discomfort, pain or any distress was reported by any of the 10 participants belonging to the SCP group who participated in the RT programme.

4.6: Kilocalorie Expenditure and Distance Covered.

The data for Kilocalorie (KC) expenditure and the walking distance covered by each participant was collected upon completion of their 10 minute usage period on each of three CV pieces of equipment and was recorded over

the six week period. Each of the 18 participants completed 180 minutes of CV supervised exercise.

The end workout data, which was provided on each piece of equipment, was devoid of any personal information such as personal bodyweight which a participant may have, prior to use, input into the equipment to allow the personalisation of feedback data for the work performed. As such, the data provided by the electronic readings of the equipment was not based on any individual's unique measurements.

Each individual was able to decide and personalise; their treadmill walking speed; their RPM pedal speed of between 60 RPM and 70 RPM, and the resistance level (1 – 20) on the stationary bicycle; their strokes per minute speed on the rowing ergometer, at a damper setting of four. There was a requirement for each participant to adhere to the guidance to maintain an RPE of 12 – 13, "somewhat hard" during each activity.

The "Levene's Test for Equality of Variances" was checked to ensure the assumption of equal variance was met for each group, which was confirmed (KC, $p = 0.43$, and for the distance variable, $p = 0.63$).

It was discovered that no significant differences were noted between the SC group and the SCP group (table seven). The extent of the difference in the mean scores recorded was 3.95, with a 95% CI: -160.04 to 167.94.

Table 7. Total Kilocalorie expenditure.

group	Total KC expenditure difference	Standard Deviation ±	Confidence Interval	P Value
SC	1179.75	194.81	1016.88 - 1342.62	0.96
SCP	1175.80	133.28	1080.46 - 1271.14	

For the distance variable, no significant difference was noted between the SC group and the SCP group results (table eight). The extent of the difference in the mean scores recorded was -0.12, with a 95% CI: -3.43 to 3.18.

Table 8. Total recorded CV equipment distance.

group	Total CV distance difference	Standard Deviation ±	Confidence Interval	P Value
SC	31.84 km	3.60	28.83 - 34.85	0.94
SCP	31.96 km	3.02	29.80 - 34.12	

4.7: Results Overview.

Data gathered from the dependent t test for each group provides the information that each of the groups did significantly increase their mean walking distance in the 10m ISWT, by 194m in the SC group and 160m in the

SCP group respectively. This evidence supports the theory that the prescribed CV exercise routine was effective in increasing the participant's functional capacity. This was, as found in seven of the eight studies reviewed earlier in the literature review. The participants demonstrated an ability to improve their walking speed as reported elsewhere (Adams et al., 1999; Beniamini et al., 1999; Butler et al., 1992; Daub et al., 1996; Kelemen et al., 1986; Pierson et al., 2001) and their walking distance which was recorded from the findings measured in the 10m ISWT.

In relation to the performance of the SCP group in comparison to the SC group, we find that the SCP group did have a mean travelling distance (672m), of 64m further in the post-intervention 10m ISWT, than the SC group did (M = 608m). However, the independent t test results observed for the 10m ISWT variable illustrates that when the differences in the cumulative distances of each participant are totalled within each group, the SC group travelled a mean distance of 34m further than the SCP group. This suggests that the SCP groups exercise regime does not provide a greater increase in functional capacity in comparison to that of the SC group. Consideration is required of the factors (e.g., age, gender, and previous physical activity history) of the participants that made up each group, as such individual differences would impact on the groups overall result. When the reviewed studies and the RT volume performed in them (times per week, exercises, sets and reps) are investigated, the closest one is still almost double the volume of this study (Adams et al., 1999).

When the actual recorded and total distances for each group are compared, we find a similar increase from the pre-intervention to the

post-intervention stages across both groups, with the SC group having a 1550m increase, up 46.8% in comparison to the SCP group's 1600m increase, up 31.3%. This is not a surprise finding as the mean performances of the groups are very similar and this suggests the effectiveness of both exercise designs to increase the CV fitness and exercise tolerance of both groups.

When the RPP data is analysed, it is interesting to note that the SC group who had the greatest increase in 10m ISWT distance illustrates a non significant ($p < 0.05$), yet greater RPP decrease of 5.9 mmHg.bpm, in comparison to the smaller decrease in the RPP of the SCP group, where a reduction of two mmHg.bpm is noted.

It would be expected that the group who had done the most work (walking speed x distance) to have had the greater mean RPP following the 10m ISWT which is not the case in this sample.

The SC group who had the higher mean RPP prior to the intervention, later demonstrated a lower mean RPP (77.6 mmHg.bpm) following the intervention, in comparison to the SCP group (80.0 mmHg.bpm). These findings are below the reported safe range of 132 - 360 mmHg.bpm during physical activity (Adams, Cline, Hubbard, McCullough, & Hartman, 2006).

The independent t-test results for the RPP variable illustrate than when the differences in the cumulative RPP measurements of each participant are totalled within each group, the SC group (M = - 5.9 mmHg.bpm) had a mean lower RPP of 3.8 mmHg.bpm in comparison to the SCP group (M = - 2.1 mmHg.bpm). this further suggests the failure of the SCP group's exercise

regime to provide a mean larger increase in functional capacity in comparison to the SC group.

The data from the KC and distance variables which were compared earlier also provide the evidence that both groups had performed very similar in relation to the CV component of the programme, and thus any differences that may have been found in the groups, in regards to their 10m ISWT performance, or RPP differences may have been attributable to the strength training, but this was not evident.

The null hypothesis that the addition of three resistance training exercises to a cardiovascular training programme does not improve functional capacity within a six week period cannot be rejected, nor can the null hypothesis that the addition of three resistance training exercises to a cardiovascular training programme does not decrease RPP scores within a six week period; as determined from the data analysis.

It is worthy to point out the positive individual performances and the individual gains which are presented in the raw data (Appendix R). These include the positive findings in regards to the SBP results that were recorded pre-10m ISWT at the pre, and post-intervention consultations. Of the 18 participants, only three failed to demonstrate a reduction in their SBP, two of whom were in the SCP group. Interestingly, these three participants had a relatively low SBP when first recorded, and thus the increase in SBP appeared to be having a normalising effect (114 mmHg increasing to 128 mmHg, 88 mmHg increasing to 107 mmHg and 121 increasing to 127 mmHg respectively).

Of the 16 participants who did show a reduction, these ranged from – 2 mmHg to – 24 mmHg. It should be noted that a decrease of at least 3 mmHg can reduce mortality, the incidence of strokes and CHD (Chobanian, Bakris, Black, Cushman, Green, & Izzo et al., 2003).

Tables providing group data, collated from the SPSS data outputs are also provided (Appendix S), as are the collective tables of both independent and dependent variables (Appendix T).

It is illustrated that in the SC group, 10m ISWT gains of up to 490m were achieved. In the SCP, large individual distances were also covered (300m).

In relation to RPP, in the SC group, an individual achieved a decrease of 17 mmHg.bpm and in the SCP an individual achieved a decrease of 19 mmHg.bpm. Whilst such reductions may not be of clinical significance they are nevertheless individual improvements which can lead to an increase in exercise tolerance and a increase in angina threshold limits. This emphasises the importance of individuality and specificity when not only prescribing but designing physical activity programmes. These factors will add to the knowledge and belief that one size certainly does not fit all.

It should also be noted that each of the 18 participants did improve their performance in the 10m ISWT and whilst the evidence points to the insignificance of RT in relation to improving functional capacity, the RT component did improve significantly the mean personal strength levels of all participants of the SCP group, reiterating the point of the specificity of an exercise routine. This latter statement matches the evidence as provided in

the reviewed studies, in that both cardiovascular and strength gains are evident in those who participate in such programmes.

In relation to the psychological well being of the participants, pre and post-intervention scoring, as measured in the HADS test; in the anxiety variable for the SC group, a non significant increase in the mean difference score of one has occurred, and in the depression variable an insignificant mean decrease of 0.4 occurred. In the SCP group, the anxiety variable shows an insignificant increase of 0.5, and in the depression variable an insignificant decrease of 0.1 is noted.

Two participants from the SC group and one from the SCP group at their pre-intervention anxiety measurements had a score greater than eight, a number regarded as being significant in determining psychological well being status. In the post-intervention analysis, this had increased to three participants from the SC group and two participants from the SCP group. In the depression variable one participant had scored greater than eight (from the SC group). Post-intervention two participants scored greater than eight, one from each group.

When a comparison is made across both groups for evidence of any increase in any single value, from pre to post-intervention; in the anxiety variable, eleven participants demonstrated an increase, three participants showed a decrease and the remaining four participants showed no change. In the depression variable, five participants demonstrated an increase, seven a decrease and six participants showed no change when measured across the same parameters.

As the HADS test considers, upon completion, the previous seven days, it is difficult to compare the scores on a like for like basis. If a participant had experienced a unique situation (loss of employment; a sentimental remembrance day, or a family breakdown), and had presented themselves for the HADS test, the scenario that may have caused an increased anxiety level or a low mood in the seven days prior to data collection, will impact on their responses. Such detriment to psychological well being would cause an increase in the score for the specific variable, due to such exceptional circumstances. This fits in with the need to consider the time period involved in using the HADS test as discussed previously (SIGN, 2002).

One other consideration that may be relevant from the findings of the HADS responses, is the fact that the participant, when completing the HADS questionnaire for the first time, may be holding back in their feelings / expressions and thus responses, due to the fact that the information is being given to a relatively unknown person, in this case the researcher. Following the intervention, and having worked closely, on a one to one basis with each other, forming a trust and a relationship together, perhaps the participant may have felt at ease, and able to be more open and expressive in their replies. A solution to this possibility would be for the HADS test to be completed by the participant without the presence of the researcher at either the pre or post-intervention test.

Whilst the value of the HADS test as a tool for the identification of those who may be at risk of psychological distress, was discussed in chapter two, further consideration into the events of the previous seven days, prior to the completion of the HADS document is required. A practioner should not merely

ask an individual to complete the form, score the form, and then make a judgement based solely on the scores, as there may be mitigating circumstances in the recorded score.

Based on the earlier non significant ($p < 0.05$) findings, the null hypothesis that the addition of three resistance training exercises to a cardiovascular training programme does not improve anxiety and depression scores within a six week period cannot be rejected.

Chapter 5. Discussion.

5.1: Introduction.

The objectives of this research study were specifically to;

1. Determine if the inclusion of a specific RT programme in a phase four setting, following a thirty minute CV exercise routine, produced greater functional improvements in comparison to the group performing CV exercise only.
2. Establish if the addition of RT caused a greater decrease in the RPP readings across the different groups from pre to post-intervention.
3. Ascertain if all participants in the project had lowered depression and / or anxiety levels upon completion of the six week intervention
4. Provide the evidence that the addition of three RT exercises to a CV exercise programme, targeting those who had experienced an MI, was not only a safe, but also an effective method to improve the strength of these individuals, and provide this knowledge to BACR qualified exercise professionals.

The specific primary research studies of the literature review for this study indicate the minimum duration, amount of movements and frequency of the RT programme designs that have been carried out by leaders in the field.

It was the intention of this study to offer a dissimilar approach, one that could potentially determine the minimum requirement that could observe improvements in the strength of participants, and observe if the RT

programme had additional carryover benefits, which could further improve the CV fitness of participants.

As such this research study was shorter in duration, frequency, and in the amount of prescribed RT exercises, in regards to the supervised RT sessions, than any of the reviewed studies observed in chapter two. It did match the CV exercise duration and prescription of a number of those same studies.

Each of the objectives shall be summarised prior to a conclusion being made as to the achievement of each objective. The chapter shall continue with suggested recommendations, followed by an evaluation of the research study.

5.2: Summary of Objectives and Conclusions.

5.2.1: Objective one summary.

Two randomised groups (an SC group and an SCP group) performed an identical CV exercise routine; the significant difference between each group was that the SCP group performed an additional component involving three RT exercises.

Whilst each group and indeed each individual demonstrated a gain in walking distance, no significant differences were found between the groups upon completion of the programme. Only three individuals failed to increase their walking distance a clinically significant difference greater than 48m (Singh, Jones, Evans, & Morgan, 2008).

What can be concluded from this is that whilst the participants of the SCP group performed a greater volume of work (CV exercise and RT exercise), than the SC group, but a similar mean amount of work as recorded in the results section (Kcal expenditure and travelling distance), the RT exercise prescription (three exercises, once per week for one set of 10 repetitions) was not enough to further develop the CV gains of the SCP group.

5.2.2: Objective two summary.

In regards to objective two, which was to establish if the SCP group would develop a superior decrease in their RPP measurements than the SC group would, due to the addition of three RT exercises. The gathered results evidence that this was not the case, in fact it appears to be the opposite.

Following a comparison of the resting RPP measurements, recorded at the pre-intervention consultation, it was found that both groups had a similar mean RPP; 84 mmHg.bpm (SC) and 82 mmHg.bpm (SCP).

Following the intervention, the SC group demonstrated a greater mean decrease of 6 mmHg.bpm in RPP values in comparison to the SCP group who illustrated a mean decrease of 2 mmHg.bpm. When the data was combined from both groups a mean reduction in the RPP values of 3.8 mmHg.bpm from 82.7 mmHg.bpm to 78.9 mmHg.bpm was observed.

When the data is compared on an individual basis, following the intervention, it is found that the highest mean RPP of 100 in the SCP group was produced by a SBP of 128 mmHg and a pulse rate of 78 bpm. In the SC

group the highest recorded RPP of 101 was produced by a SBP of 144 and a pulse rate of 70 bpm.

It can be concluded that the addition of the RT exercise programme, as that which was prescribed to the SCP group, was ineffective in its ability to lower the mean RPP values, to levels below those attained by the SC group.

5.2.3: Objective three summary.

Objective three was to establish if the six weeks intervention lowered pre-anxiety and / or depression scores as measured using the HADS test in comparison to the post-intervention scores.

It was found that in the SC group, the post-intervention mean anxiety score was up one point from five points to six points. In the depression variable, a mean score decreased by one point to three points.

In the SCP group, post-intervention mean scores, the anxiety variable increased one point from four to five, with the depression variable demonstrating no change, remaining at two points.

The groups combined mean anxiety scores at pre-intervention was 4.4 points, and at post-intervention a 0.8 increase occurred taking the value up to 5.2 points. For the depression combined mean scores, the pre-intervention values were recorded at 2.7 with the post-intervention values illustrating a decrease of 0.2 points down to 2.4 points.

All of these mean scores were less than 8 points, and as such were not of a level that would require a specific intervention as discussed in chapter 2.7.

It can be concluded that the intervention did not cause the mean anxiety, or the mean depression values to appreciably alter. However, when the individual values of each participant are investigated, there are notable increases, decreases, and also no changes, even when the values of a variable were greater than 8 points or greater than 11 points in some cases.

The HADS test and the timing of a repeat test should be treated on an individual needs basis and requires a detailed analysis of the scores, when the scores are of at least greater than 8 points, as such scores may require specific psychological intervention.

5.2.4: Objective four summary.

The final objective was to provide the evidence and knowledge to BACR qualified exercise professionals that RT, could and should be included in their exercise prescriptions, at the earliest opportunity to post-MI patients, who have no contra-indications to such exercises. RT is a safe, effective and specific method to improve the strength of the individuals participating in CRP's. RT can ultimately promote an individual's independence and their ability to carry out everyday tasks with a reduced muscular effort, and may allow individuals an ability to potentially overcome previously unachievable tasks that specifically involve muscular strength.

In conclusion, it was found that the RT programme design, of one set, of 10 repetitions was effective in improving the mean strength of the SCP group participants from their pre to post-intervention 10 RM tests.

Strength was improved in the group as observed in the mean increases in the amount of weight lifted, which was 12 kg, 6.8 kg and 4.5 kg for the leg, back and chest exercises respectively.

When we consider the individual achievements of each of the 10 participants we find that all improved their leg strength, nine improved their back strength and eight improved their chest strength.

It is notable that as the muscle groups become smaller in mass, fewer participants are observed as demonstrating an improvement in their strength. This, in all likelihood was due to the minimum amount of weight that could be added, due to the pre-fixed weight of each block within the equipment. If it was possible to increase the weight load in smaller increments such as 0.25kg's, or even less when applicable, then relative strength gains may have been possible.

In the RBH hospital based CRP, no such luxury of access to state of the art RT equipment is available, unlike that which was utilised by the participants in DVRG. However, the hospital based programme does have a small selection of dumbbells ranging in weights from 0.25kg's to 2.5kg's. These weights could be utilised in a RT component to initiate not only an understanding, but an acceptance of the inclusion of progressive strength training at an early stage in the rehabilitation of the patients.

5.3: Recommendations.

Based on the findings and the subsequent conclusions of this study, it would first be recommended that the intervention that was presented in this

study be developed and delivered on one additional day per week, providing an additional structured and supervised session. The benefits of an additional day in the intervention would allow for the participants to maintain their CV fitness levels or indeed their gains, whilst they continue to remain physically active. The RT workload would double in theory; would still provide a period of time to allow personal recuperation to occur and thus may permit a greater amount of strength to be developed, which could also further improve the CV fitness levels of the participants and thus match the gains noted in the reviewed studies. These additional CV and RT exercises may also elicit greater physiological responses in the myocardium and in the heart which may allow for differences in the RPP values to become notably different in all individuals.

Finally it would be recommended that a similar study improve the catchment area for participants and not to inadvertently restrict the amount of sites that can deliver the study. The more sites that are available, the more prospects for greater participation and a robust research study.

Both of the above recommendations are dependent on the available time that prospective investigators can dedicate and ultimately invest towards their study.

5.4: Evaluation.

The effort that has been required to allow this study, and the intervention itself, from the early beginnings as a simple idea, to its fulfilment, has been justly rewarded.

The frustrations of not having the participants referred from the hospital CRP in greater numbers, to allow for a larger participation population, were often forgotten due to the enthusiasm of the 18 participants who did take part in the study.

Knowing that each individual made personal achievements in part, due to the design of the exercise programme, for which they were both thankful and grateful, is very fulfilling. The self achievements of all the participants, who had suffered such a serious illness a short time period before participation in the programme, and their courage to do what had been asked of them has to be commended.

Finally as a recommendation to others who begin a similar research study; grasp the opportunity to work with those who are referred into your CRP's, and whilst statistically the findings may be small or statistically insignificant, the personal differences that individuals can make, and the positive impact on their lives, will make it a very rewarding study.

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Appendices

Appendix A

Hospital Anxiety Depression Scale (HADS)

Subject Number ……..…….. Date…..……

Emotions play an important part in most illnesses.

This questionnaire is designed to help us know how you feel.

Read each item and underline the reply which comes closest to how you have been feeling in the past week.

Don't take too long over your replies: your immediate reaction to each item will probably be more accurate than a long thought out response.

I feel tense or 'wound up':
Most of the time
A lot of the time
Time to time, occasionally
Not at all

I feel as if I am slowed down:
Nearly all of the time
Very often
Sometimes
Not at all

I still enjoy the things I used to enjoy:
Definitely as much
Not quite so much
Only a little
Not at all

I get a sort of frightened feeling like 'butterflies in the stomach':
Not at all
Occasionally
Quite often
Very often

I get a sort of frightened feeling like something awful is about to happen:
Very definitely and quite badly
Yes, but not too badly
A little, but it doesn't worry me
Not at all

I have lost interest in my appearance:
Definitely
I don't take as much care as I should
I may not take quite as much care
I take just as much care as ever

I can laugh and see the funny side of things:

As much as I always could
Not quite so much now
Definitely not so much now
Not at all

I feel restless as if I have to be on the move:

Very much indeed
Quite a lot
Not very much
Not at all

Worrying thoughts go through my mind:

A great deal of the time
A lot of the time
From time to time but not too often
Only occasionally

I look forward with enjoyment to things:

A much as I ever did
Rather less than I used to
Definitely less than I used to
Hardly at all

I feel cheerful:

Not at all
Not often
Sometimes
Most of the time

I get sudden feelings of panic:

Very often indeed
Quite often
Not very often
Not at all

I can sit at ease and feel relaxed:

Definitely
Usually
Not often
Not at all

I can enjoy a good book or radio or TV programme:

Often
Sometimes
Not often
Very seldom

Appendix B

Shuttle Walk Test

Verbal consent gained: Yes ☐ No ☐

Subject Number; Date. Time.

Pre-Test BP ♥: / Exercise contraindicated if BP >180/100	Pre-Test HR ♥: Exercise contraindicated if HR <45bpm
Beta blocked: Y / N	<u>THR: heart rate reserve</u> 40% - 50% - 60% -
Post-Test BP ♥: /	Post-Test HR ♥:
Subject feedback / RPE:	Comments: Pre RPP – Pst RPP -

Level 1: ♥ ♥ ♥ 1.12 mph / 1.8 kph / 20 secs (30m)

Level 2: ♥ ♥ ♥ ♥ 1.5 mph / 2.41 kph / 15 secs (70m)

Level 3: ♥ ♥ ♥ ♥ ♥ 1.88 mph / 3.03 kph / 12 secs (120m)

Level 4: ♥ ♥ ♥ ♥ ♥ ♥ 2.26 mph / 3.64 kph / 10 secs (180m)

Level 5: ♥ ♥ ♥ ♥ ♥ ♥ ♥ 2.64 mph / 4.25 kph / 8.57 secs (250m)

Level 6: ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ 3.02 mph / 4.86 kph / 7.5 secs (330m)

Level 7: ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ 3.4 mph / 5.47 kph / 6.66 secs (420m)

Level 8: ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ 3.78 mph / 6.08 kph / 6 secs (520m)

Level 9: ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ 4.16 mph / 6.69 kph / 5.45 secs (630m)

Level 10: ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ 4.54 mph / 7.31 kph / 5 secs (750m)

Level 11: ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ 4.92 mph / 7.92 kph / 4.61 secs (880m)

Level 12: ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ 5.3 mph / 8.53 kph / 4.28 secs (1020m)

Appendix C

Resistance Training Equipment

Lying Leg Press

High Pulley

Lying Chest Press

Appendix D

Available Resistance with Pin Choice

Weight Selection ; Pin / Weight

Pin No	High Pulley	Chest Press	Leg Press
1	8	10	10
2	13	12.5	20
3	18	15	30
4	23	17.5	40
5	28	20	50
6	35	25	60
7	42	30	70
8	49	35	80
9	56	40	90
10	63	45	100
11	70	50	110
12	77	55	120

Appendix E

Ethics Approval Letter

Mark Campbell
11 July 2008

Dear Mark,

Study title: **Does resistance training, combined with aerobic training, further improve cardiovascular fitness?**
FREC reference: **231/08/MC/CENS**
Version number: **2**

Thank you for your letter dated June 2008, responding to the Faculty of Applied and Health Sciences Research Ethics Committee's request for further information.

The further information has been considered on behalf of the Committee by Alison Roberts, as lead reviewer, and Simon Alford, acting on behalf of the Chair of the Faculty Research Ethics Committee.

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form and supporting documentation, as revised.

The favourable opinion is given provided that you comply with the conditions set out in the attached document. You are advised to study the conditions carefully.

The final list of documents reviewed and approved by the Committee is as follows:

Document	Version	Date
Application Form	1	May 2008
Participant Information Sheet	2	June 2008
Consent Form	1	May 2008
PAR-Q	1	May 2008
Phase IV CR – client participation form	1	May 2008
DOMS fact sheet	2	June 2008
Subject number allocation sheet	1	May 2008
Physical activity monitoring diary	1	May 2008
Shuttle walk recording sheet	1	May 2008
HADS questionnaire	1	May 2008
Flowchart	1	May 2008
Risk assessment form	1	May 2008
HR monitoring protocol	1	May 2008
BP monitoring protocol	1	May 2008
Shuttle walk test protocol	1	May 2008
Letters of permission from Blackburn with Darwen BC	-	May 2008
Response to FREC's request for further information	1	June 2008

With the Committee's best wishes for the success of this project.

Yours sincerely,

Stephen Fallows

Chair, Faculty Research Ethics Committee

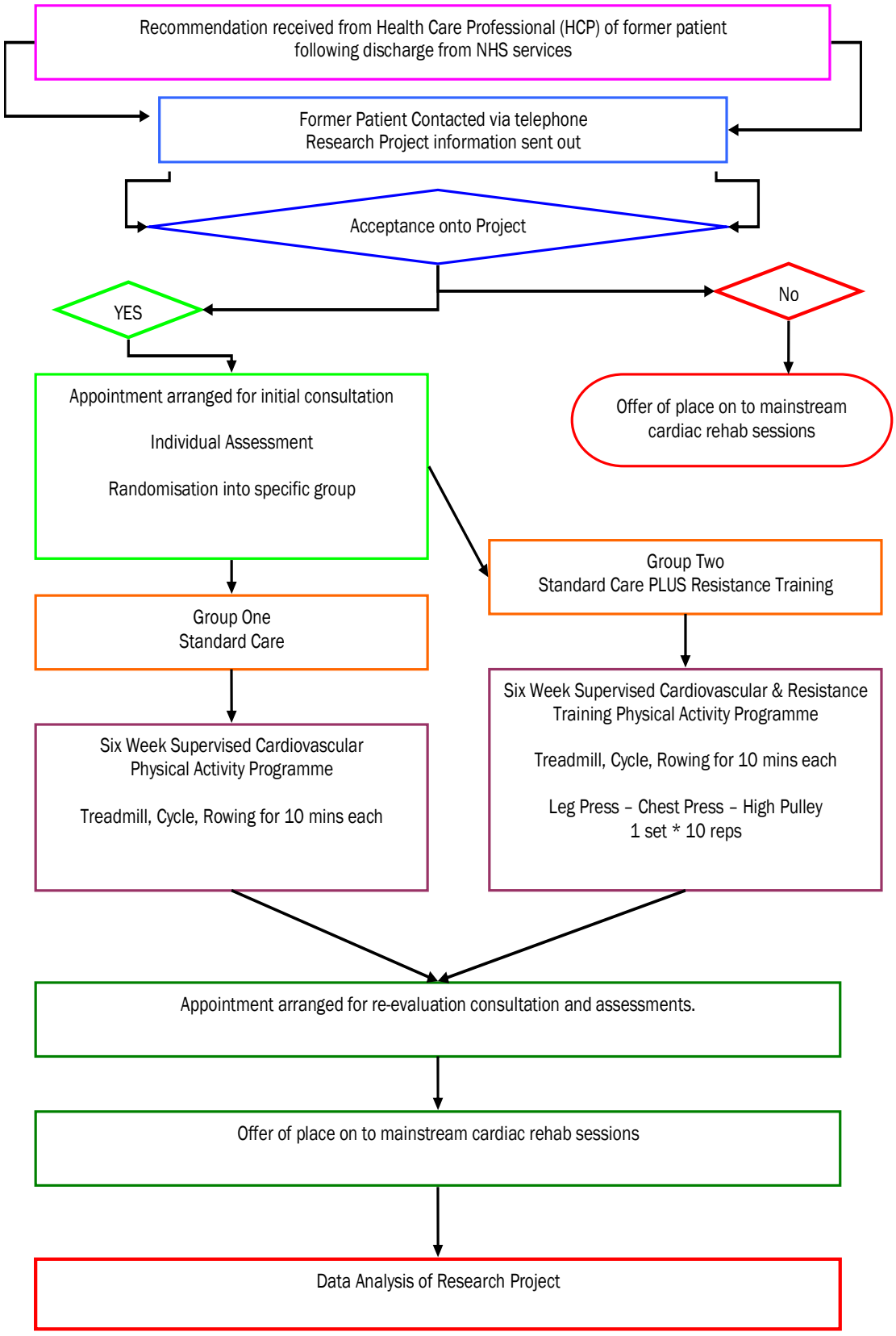
Enclosures Standard conditions of approval.

c.c.: Supervisor

FREC Departmental/Centre Representative

Appendix F

Research Pathway



Appendix G

Consent Form

Title of Study: Does Resistance Training, combined with Aerobic Training, further improve Cardiovascular Fitness?

Name of Researcher: Mark Campbell.

Please initial box

1. I confirm that I have read and understand the information sheet dated ……for the above study and have had the opportunity to ask questions. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason and without my care or legal rights being affected. ☐

3. I understand that sections of any of my medical notes may be looked at by responsible individuals from regulatory authorities where it is relevant to my taking part in research. I give permission for these individuals to have access to my records. ☐

4. I agree to take part in the above study. ☐

_____	_____	_____
Name of Participant	Date	Signature
_____	_____	_____
Name of Person taking consent (if different from researcher)	Date	Signature
_____	_____	_____
Researcher	Date	Signature

One copy given to participant. One copy retained by researcher.

Appendix H

Participant Information Sheet

Does Resistance Training, combined with Aerobic Training, further improve Cardiovascular Fitness.

You are being invited to take part in a research study. Before you decide to take part in the study, it is very important for you to understand why the research study is being done and what it involves. Please take time to read the following information carefully and feel free to discuss it with others if you wish. Please ask if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Thank you for reading this information sheet.

What is the purpose of the study?

This study aims to discover if the addition of three resistance exercises can increase your cardiovascular fitness. The resistance exercises will complement the aerobic training exercises that you will do whilst participating in our programme.

A written report will be produced at the end of the study. You will not be identifiable in the final report.

Why have I been chosen?

You have been chosen because you were a patient who attended and completed the Royal Blackburn Hospital (RBH) cardiac rehabilitation programme. You have agreed to be referred by the RBH team in an effort to remain physically active.

Do I have to take part?

You do not have to take part; the decision to do so is yours. If you decide to take part, you are still free to withdraw at any time and without giving a reason.

A decision to leave at any time, or a decision not to take part, will not affect the standard of care you receive in any way.

Standard care on this occasion refers to you taking part in the Blackburn with Darwen Borough Council cardiac rehabilitation programme which allows you to be physically active in a supervised setting.

What will happen to me if I take part?

If you decide to take part, you will be asked to sign a consent form.

I will arrange a one to one consultation at a suitable time for you, where we will carry out combined a blood pressure and heart rate measurement. We will carry out a walking test. The walking test is the one you did prior to joining the hospital based cardiac rehabilitation programme. I will also ask you to complete a questionnaire. You will be given a physical activity recording diary, to record the activities that you perform at home.

You will then be randomly placed into a group that will either receive standard care, which involves the use of aerobic exercise equipment; a treadmill, a rowing machine and a cycle, for 10 minutes each, or standard care, plus three resistance exercises for a six week period. Following completion of the six week period, we shall arrange to have a repeat of our initial consultation.

What are the possible disadvantages and risks of taking part?

There are no disadvantages or risks foreseen in taking part in the study.

What are the possible benefits of taking part?

Through participating in the study you will be contributing to the development of the Borough Council's cardiac rehabilitation programme. The study may indicate the potential benefits that can be made by simply adding three resistance exercises to the standard exercise design.

What if something goes wrong?

If you wish to complain or have any concerns about any aspect of the way you have been approached or treated during the course of this study, please contact Professor Sarah Andrew, Dean of the School of Applied and Health Sciences, University of Chester, Parkgate Road, Chester, CH1 4BJ, 01244 513055.

If you are harmed by taking part in this research project, there are no special compensation arrangements. If you are harmed due to someone's negligence (but not otherwise), then you may have grounds for legal action but you may have to pay for this.

Will my taking part in the study be kept confidential?

All information which is collected about you during the course of this research will be kept strictly confidential so that only I will have access to the information. You will be given a unique number which will be used on all information collected from you. You will not be identified in the subsequent publication.

What will happen to the results of the research study?

The results will be written up into a publication. The findings may be used to improve the service provided.

Who is organising and funding the research?

This research will receive no external funding. The study will involve The Centre for Exercise and Nutrition Science at the University of Chester.

Who may I contact for further information?

If you would like more information about the research before you decide whether or not you would be willing to take part, please contact myself;

Mark Campbell
01254 682053

mark.campbell@blackburn.gov.uk

Thank you for your interest in this research.

Appendix I

Risk Stratification.

High:

Ejection fraction < 40%.

Complex ventricular arrhythmias at rest / appearing or increasing on exercise.

Presence of CHF.

>2mm exercise induced ST segment depression at < 5 METs on Bruce.

History of cardiac arrest / sudden death.

Complicated MI revascularisation.

Primary VF. ST segment depression > 1mm on resting ECG.

Presence of post event / procedure Ischaemia.

High level of silent Ischaemia ≥ 2mm from baseline.

Presence of angina / SOB / dizziness at < 5 METs / during recovery.

Presence of post exercise hypotension / flat or decreasing BP on exercise.

Presence of clinical depression.

Medium:

Functional Capacity > 5 METs.

Angina / SOB / dizziness at ≥7 METs.

ST segment depression < 2mm on ETT.

Mild to moderate LV function (EF 40 – 49%).

Failure to comply with exercise programme.

Low:

Uncomplicated MI / CABG / PTCA

Functional capacity ≥7 METs

Absence of post event / procedure Ischaemia.

No resting or exercise induced Ventricular Arrhythmias.

Absence of angina, SOB, dizziness during ETT.

Normal BP / pulse rate during ETT.

Absence of CHF.

Rest ejection fraction ≥ 50%.

Absence of clinical depression.

Appendix J

Random Sampling Procedure

Assign subjects to groups.

Subject / Group Assigned:

1 ;	A.	2 ;	B.	3 ;	A.	4 ;	A.
5 ;	B.	6 ;	A.	7 ;	A.	8 ;	B.
9 ;	A.	10;	B.	11 ;	A.	12 ;	B.
13 ;	A.	14 ;	A.	15 ;	B.	16 ;	B.
17 ;	B.	18 ;	A.	19 ;	B.	20 ;	B.

How it works: The random number generator is seeded with the time of day, so it works differently each time you use it. Each subject is first assigned to a group non-randomly. Then the assignment of each subject is swapped with the group assignment of a randomly chosen subject. This should suffice, but the entire process is repeated twice to make sure it is really random. Note that you can copy and paste the values from the web page into Excel.

Web Site Address; http://www.graphpad.com/quickcalcs/randomize2.cfm

Date & Time of procedure; 13/07/2008 17:33:43

Group A – Standard Care Plus.
Group B – Standard Care.

Appendix K

Delayed Onset Muscle Soreness Advice Sheet

During your initial physical activity sessions you may encounter an activity / activities that you and your body are not familiar with.
This may lead to a general muscle soreness that is felt in areas of your body that you have been exercising.

We aim to minimise the potential of feeling any soreness through a steady and progressive approach which is intended for you in your physical activity programme.

We refer to this type of soreness as the Delayed Onset Muscle Soreness (DOMS).

DOMS is common when resistance training is initially introduced as part of your physical activity programme. The soreness usually presents in the first day or two following your initial session and gradually subsides as the days pass.

There are many theories as to what actually causes DOMS including a warm-up period and many theories as to what can ease the discomfort that DOMS may cause.

It has been found that light physical activity was more successful than rest in alleviating the discomfort of DOMS. As such, gentle walking may help you to reduce any potential muscle soreness that may be felt.

It has also been found, that massage did reduce the discomfort brought on by DOMS.

Appendix L

SC Group Training Record Card

Date	Tred	Bike	Row
Week 1	**10 Mins** kph **km** kc	**10 Mins** Lev **km** kc	**10 Mins** Lev 4 **m** kc
Week 2	**10 Mins** kph **km** kc	**10 Mins** Lev **km** kc	**10 Mins** Lev 4 **m** kc
Week 3	**10 Mins** kph **km** kc	**10 Mins** Lev **km** kc	**10 Mins** Lev 4 **m** kc
Week 4	**10 Mins** kph **km** kc	**10 Mins** Lev **km** kc	**10 Mins** Lev 4 **m** kc
Week 5	**10 Mins** kph **km** kc	**10 Mins** Lev **km** kc	**10 Mins** Lev 4 **m** kc
Week 6	**10 Mins** kph **km** kc	**10 Mins** Lev **km** kc	**10 Mins** Lev 4 **m** kc

Date / Time	**B/P Measurement** **Pre activity.**	**Post activity.**	**Comments**
e.g. 10/02/05 14.35	**140 / 80 p 75.**	**155 / 83 p 84.**	RPP 105 130
	/ . p .	/ . p .	RPP
	/ . p .	/ . p .	RPP
	/ . p .	/ . p .	RPP
	/ . p .	/ . p .	RPP
	/ . p .	/ . p .	RPP
	/ . p .	/ . p .	RPP

Subject Number:

Appendix M

SCP Group Training Record Card

Date	Tred	Bike	Row	Resistance – 1 set * 10 reps.
Week 1	Mins kph km kc	Mins Lev km kc	Mins Lev m kc	Leg Press. Maximum kg High Pulley. Maximum kg Chest Press. Maximum kg
Week 2	Mins kph km kc	Mins Lev km kc	Mins Lev m kc	kg kg kg
Week 3	Mins kph km kc	Mins Lev km kc	Mins Lev m kc	kg kg kg
Week 4	Mins kph km kc	Mins Lev km kc	Mins Lev m kc	kg kg kg
Week 5	Mins kph km kc	Mins Lev km kc	Mins Lev m kc	kg kg kg
Week 6	Mins kph km kc	Mins Lev km kc	Mins Lev m kc	kg kg kg

Date / Time	B/P Measurement Pre activity.	Post activity.	Comments
e.g. 10/02/05 14.35	**140 / 80 p 75.**	**155 / 83 p 84.**	RPP 105 130

Subject Number:

Appendix N

Methods of Monitoring Intensity

Exercise training level	Rate of perceived exertion (Borg)	Perceived breathing rate	% Maximal heart rate from symptom limited
	6 No exertion at all		
	7 Very, very light		
	8		
	9 Very light		
	10		
LOW	11 Fairly light	SING	50 – 60
	12		
MODERATE	13 Somewhat hard	TALK	60 – 75
	14		
HIGH	15 Hard (heavy)	GASP	75 – 85
	16		
	17 Very hard		
	18		
	19 Very, very hard		
	20 Maximal exertion		

Appendix O

Borg's RPE Scale Instructions.

While exercising we want you to rate your effort of perceived exertion, i.e., how heavy and strenuous the exercise feels to you.
The perception of exertion depends mainly on the strain and fatigue in your muscles and on your feeling of breathlessness or aches in the chest.

Look at this rating scale; we want you to use this scale from **6** to **20**, where **6** means "no exertion at all" and **20** means "maximal exertion".

9 Corresponds to " very light" exercise. For a healthy person it is like walking slowly at their own pace for some minutes.

13 The scale is "somewhat hard" exercise, but it still feels ok to continue.

17 "Very hard" is very strenuous. A healthy person can still go on, but they really have to push themselves. It feels very heavy, and the person is very tired.

19 On the scale is an extremely strenuous exercise level. For most people this is the most strenuous exercise they have ever experienced.

Try to appraise your feeling of exertion as honestly as possible, without thinking about what the actual physical load is.

Don't underestimate it, but don't overestimate it either.

It's your own feeling of effort and exertion that's important, not how it compares to other people. What other people think is not important either.

Look at the scale and the expressions and then give a number.

This should be done during and not at the end of the exercises.

BORG RPE SCALE

6 No exertion at all

7

Extremely light

8

9 Very light

10

11 Light

12

13 Somewhat hard

14

15 Hard (heavy)

16

17 Very hard

18

19 Extremely hard

20 Maximal exertion

Appendix P

Programme Evaluation Questionnaire

1. Have you noticed any improvements to your health and well being as a result of the programme?

☐	more flexible	☐	better balance
☐	reduction in pain	☐	feel more relaxed
☐	more confident	☐	sleeping better
☐	become more active	☐	less anxious
☐	other_____		

2. Did you find the Gym class interesting?

   Very interesting 1_____2_____3_____4_____5 Not at all interesting

   If not at all – can you suggest anything to make it more interesting?

3. Was the class clear and easy to follow? Yes / No

   Was the class at the right pace for you? Yes / If Not: Was It Too fast / Too Slow

4. Is the venue convenient for you to get to? Yes ☐ No ☐

   If no, please specify the problem/s

5. Do you think that taking part in the programme has helped you manage your heart condition? Yes/No

   If yes, please describe how the programme has helped.

6. Do you feel you are ready to move onto a further programme of exercise? Yes/No If no, then why not?

7. What type of exercise would you like to try next? Please tick all that apply

☐ A full Tai Chi class ☐ Led Walks

☐ Circuit Class ☐ Gym Session

☐ Movement to Music ☐ Easy Exercise

☐ Don't Know

Rating the scheme

1. How satisfied are you with the programme?

Very pleased		Satisfied/OK		Dissatisfied
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

2. Please state any aspects of the programme that you did not like?

3. Can you suggest anything that should be changed or added to improve the scheme?

4. Disability Yes ☐ No ☐

5. Ethnicity Bangladeshi Black African Black Caribbean Indian
Pakistani White Chinese Black
Other (please specify)

Thank you for completing this questionnaire.

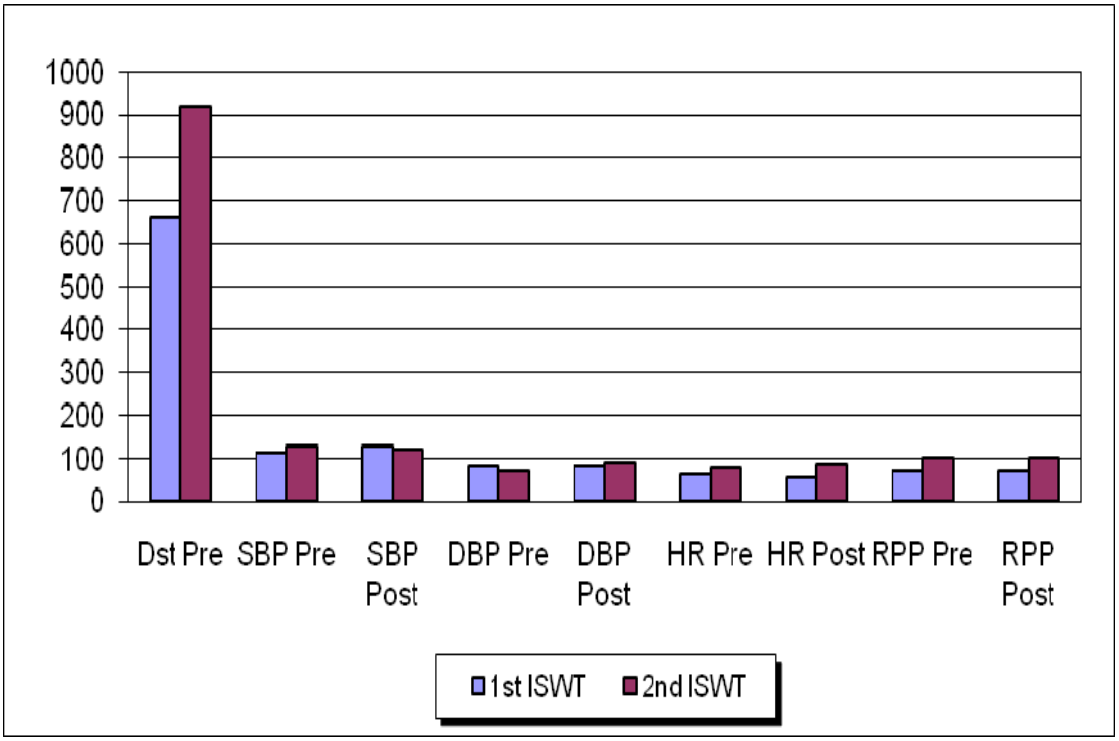
Appendix Q

Sample Participant Handout

1st ISWT	Dst Pre	SBP Pre	SBP Post	DBP Pre	DBP Post	HR Pre	HR Post
	660	114	128	81	81	63	56
2nd ISWT	**Dst Pst**	**SBP Pre**	**SBP Post**	**DBP Pre**	**DBP Post**	**HR Pre**	**HR Post**
	920	128	122	71	88	78	84
Diffs	260	14	-6	-10	7	15	28

RPP Pre	RPP Post
72	72
RPP Pre	**RPP Post**
100	102
28	31

	Anxiety	Depression
Pre	7	4
Post	9	5
Diff	2	1



Appendix R

Raw Data from SPSS Data Collection

Systolic Blood Pressure Pre 10m ISWT.

Participant	Group	Pre Intervention	Post Intervention	**Difference**
1	SCP	173	149	**-24**
3	SCP	130	124	**-6**
4	SCP	157	152	**-5**
6	SCP	165	150	**-15**
7	SCP	114	128	**14**
9	SCP	145	132	**-13**
11	SCP	138	136	**-2**
13	SCP	155	140	**-15**
14	SCP	88	107	**19**
18	SCP	142	120	**-22**
2	SC	128	121	**-7**
5	SC	157	148	**-9**
8	SC	159	144	**-15**
10	SC	145	122	**-23**
12	SC	130	121	**-9**
15	SC	129	125	**-4**
16	SC	121	127	**6**
17	SC	152	148	**-4**

10m ISWT Performance

Subject	Age	Gender	Meds	Group	DWPre	DWpost	DiffWalk
1	66	Male	4	SCP	390	420	30
3	68	Male	5	SCP	540	560	20
4	53	Male	5	SCP	450	540	90
6	65	Male	5	SCP	670	780	110
7	56	Male	5	SCP	660	920	260
9	45	Male	6	SCP	570	870	300
11	46	Female	3	SCP	550	760	210
13	64	Male	6	SCP	380	660	280
14	67	Male	5	SCP	370	460	90
18	43	Female	5	SCP	540	750	210
2	58	Male	6	SC	360	550	190
5	63	Male	3	SC	370	570	200
8	64	Male	7	SC	470	960	490
10	72	Male	3	SC	310	350	40
12	63	Female	3	SC	300	650	350
15	62	Male	4	SC	690	810	120
16	55	Male	4	SC	480	570	90
17	63	Male	3	SC	330	400	70
				Average			
	59.6		**4.6**		**468.3**	**643.3**	**175.0**

Rate Pressure Product and HADS scoring

Subject	RPPpre	RPPpost	DiffRPP	AnxPre	AnxPost	DiffAnxi	DEPpre	DEPpost	DiffDepr
1	100	91	-9	1	2	1	0	0	0
3	68	73	5	3	4	1	1	1	0
4	97	81	-16	5	5	0	1	1	0
6	112	93	-19	1	5	4	1	0	-1
7	72	100	28	7	9	2	4	5	1
9	83	74	-9	4	2	-2	3	1	-2
11	83	88	5	11	11	0	6	8	2
13	84	84	0	1	2	1	0	1	1
14	44	54	10	1	1	0	1	0	-1
18	78	62	-16	6	4	-2	1	0	-1
2	104	91	-13	11	12	1	11	11	0
5	71	67	-4	2	9	7	0	1	1
8	97	101	4	1	2	1	2	1	-1
10	87	78	-9	1	3	2	3	3	0
12	90	73	-17	5	5	0	3	1	-2
15	74	66	-8	9	3	-6	5	3	-2
16	57	64	7	6	7	1	1	1	0
17	88	81	-7	5	8	3	5	6	1
					Average				
	82.7	**78.9**	**-3.8**	**4.4**	**5.2**	**0.8**	**2.7**	**2.4**	**-0.2**

10 Repetition Maximum Resistance Training Performance

Subject	Ten Pre Leg	Ten Post Leg	Leg Diff	Ten Pre Back	Ten Post Back	Back Diff	Ten Pre Chest	Ten Post Chest	Chest Diff
1	70	90	20	28	42	14	25	35	10
3	80	100	20	23	28	5	35	35	0
4	100	110	10	35	42	7	25	25	0
6	100	110	10	42	49	7	30	35	5
7	60	70	10	28	35	7	25	30	5
9	90	100	10	35	42	7	30	35	5
11	60	70	10	28	35	7	20	25	5
13	70	80	10	42	42	0	25	30	5
14	60	70	10	28	35	7	20	25	5
18	80	90	10	28	35	7	25	30	5
Average									
	77.0	**89.0**	**12.0**	**31.7**	**38.5**	**6.8**	**26.0**	**30.5**	**4.5**

KiloCalorie Expenditure , Distance Travelled and Time

Subject	CV KC Exp	CV Tot Dst	CV Tot Time
1	1009	27	180
3	1416	35	180
4	1136	29	180
6	1304	35	180
7	1246	33	180
9	1015	29	180
11	1119	35	180
13	1134	30	180
14	1089	34	180
18	1290	34	180
2	1178	32	180
5	1383	34	180
8	1276	33	180
10	1115	28	180
12	996	28	180
15	1207	36	180
16	1436	36	180
17	847	28	180
	Average		
	1177.6	**32.0**	**180.0**

Appendix S

SPSS Data Tables

SC Group. Pre and Post-Intervention Analysis.

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
ISWT Post Prog Distance - ISWT Pre Prog Distance	193.75	154.64	54.67	64.47	323.03	3.54	7	0.01
RPP Post Prog - RPP Pre Prog	-5.88	8.08	2.86	-12.63	0.88	-2.06	7	0.08
Anx Score Post Prog - Anx Score Pre Prog	1.13	3.60	1.27	-1.89	4.14	0.88	7	0.41

SCP Group Pre-Intervention. Assumption of Normality Test.

	Shapiro-Wilk		
	Statistic	df	Sig.
ISWT Pre Prog Distance	0.91	10	0.26
RPP Pre Prog	0.96	10	0.83
Anx Score Pre Prog	0.87	10	0.09
Dep Score Pre Prog	0.80	10	0.02
TenPreLeg	0.88	10	0.14
TenPreBack	0.84	10	0.05
TenPreChest	0.89	10	0.15

SCP Group Post-Intervention. Assumption of Normality Test.

	Shapiro-Wilk		
	Statistic	df	Sig.
ISWT Post Prog Distance	0.95	10	0.66
RPP Post Prog	0.96	10	0.82
Anx Score Post Prog	0.87	10	0.09
Dep Score Post Prog	0.67	10	0.01
TenPostLeg	0.88	10	0.15
TenPostBack	0.91	10	0.26
TenPostChest	0.81	10	0.02

SCP Group. Data Results.

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
ISWT Post Prog Distance - ISWT Pre Prog Distance	160.00	104.24	32.97	85.43	234.57	4.85	9	0.00
RPP Post Prog - RPP Pre Prog	-2.10	14.63	4.63	-12.56	8.36	-0.45	9	0.66
Anx Score Post Prog - Anx Score Pre Prog	0.50	1.78	0.56	-0.77	1.77	0.89	9	0.40
TenPostLeg - TenPreLeg	12.00	4.22	1.33	8.98	15.02	9.00	9	0.00
TenPostBack - TenPreBack	6.80	3.36	1.06	4.40	9.20	6.40	9	0.00

SCP Group. Independent T-Test Data.

	Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ISWT Pre Prog Distance	0.07	0.79	-1.73	16	0.10	-98.25	56.74	-218.54	22.04
ISWT Post Prog Distance	0.01	0.91	-0.74	16	0.47	-64.50	87.73	-250.48	121.48
RPP Pre Prog	0.05	0.83	0.17	16	0.87	1.40	8.25	-16.08	18.88
RPP Post Prog	0.13	0.73	-0.36	16	0.72	-2.38	6.55	-16.25	11.50
Anx Score Pre Prog	0.02	0.88	0.61	16	0.55	1.00	1.65	-2.50	4.50
Anx Score Post Prog	0.29	0.60	1.02	16	0.32	1.63	1.59	-1.74	4.99

SC Group and SCP Group. Test of Normality.

		Shapiro-Wilk		
		Statistic	df	Sig.
Walking Dist Diff	SC plus	0.91	10	0.27
	SC	0.88	8	0.19
RPP Diff	SC plus	0.92	10	0.36
	SC	0.95	8	0.71
Anxiety Scores Diff	SC plus	0.93	10	0.40
	SC	0.89	8	0.23
Depression Scores Diff	SC plus	0.95	10	0.69
	SC	0.88	8	0.17

SC Group and SCP Group. Mean Differences.

	Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Walking Dist Diff	0.49	0.50	0.55	16	0.59	33.75	61.07	-95.71	163.21
RPP Diff	3.08	0.10	-0.65	16	0.52	-3.78	5.79	-16.04	8.49
Anxiety Diff	0.80	0.39	0.48	16	0.64	0.63	1.30	-2.12	3.37
Depression Diff	0.03	0.88	-0.49	16	0.63	-0.28	0.57	-1.48	0.93

Appendix T

SPSS Data Summary Tables

Summary data of the Dependent T-test of each group.

	Intervention Status	Variable	M (SD)	Range	M Diff	P value
Standard Care (SC)	Pre	ISWT	414 (130.6)	300 - 690	194	0.009
	Post		608 (200.9)	350 - 960		
	Pre	RPP	83.5 (15.2)	57 - 104	-5.9	0.079
	Post		77.6 (13.0)	64 - 101		
	Pre	Anx	5 (3.7)	1 to 11	1.1	0.406
	Post		6.1 (3.5)	2 to 12		
	Pre	Dep	3.8 (3.4)	0 - 11	-0.4	0.402
	Post		3.4 (3.5)	1 to 11		
Standard Care Plus (SCP)	Pre	ISWT	512 (110.3)	370 - 670	160	0.001
	Post		672 (171.5)	420 - 920		
	Pre	RPP	82 (18.9)	44 - 112	-2	0.661
	Post		80 (14.4)	54 - 100		
	Pre	Anx	4 (3.3)	1 to 11	0.5	0.397
	Post		4.5 (3.2)	1 to 11		
	Pre	Dep	1.8 (1.9)	0 - 6	-0.1	0.798
	Post		1.7 (2.7)	0 - 8		
	Pre	Leg Ex	77 (15.7)	60 - 100	12	0.000
	Post		89 (16.0)	70 - 110		
	Pre	Back Ex	31.7 (6.5)	23 - 42	6.8	0.000
	Post		38.5 (6.0)	28 - 49		
	Pre	Chest Ex	26 (4.6)	20 - 35	4.5	0.001
	Post		30.5 (4.4)	25 - 35		

Summary data of the Independent T-test of each group.

	Intervention Status	Variable	M Diff	P value
Standard Care (SC) and Standard Care Plus (SCP) Groups.	Pre	ISWT	98.25	0.10
	Post		64.50	0.47
	Pre	RPP	-1.40	0.87
	Post		2.38	0.72
	Pre	Anx	-1.00	0.55
	Post		-1.63	0.32
	Pre	Dep	-1.95	0.15
	Post		-1.68	0.27
	Pre Post	Walk Diff	-33.75	0.59
	Pre Post	RPP Diff	3.78	0.52
	Pre Post	Anx Diff	-0.63	0.64
	Pre Post	Dep Diff	0.28	0.63