



MUSCLING UP AGAINST DISABILITY

P R O J E C T R E P O R T

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LETTER OF TRANSMITTAL

The Hon Christian Porter MP
Minister for Social Services
Parliament House
Canberra ACT 2600

Dear Minister,

I am pleased to present to you the project report from the Muscling Up Against Disability program funded under the Commonwealth of Australia Department of Social Services Aged Care Service Improvement and Healthy Ageing Grant [Grant ID: 4-Z35FF5, awarded March 2015].

At Burnie Brae, providing social engagement opportunities and wellbeing activities for older Australians are major components of our corporate mission. In accordance with this, the Muscling Up Against Disability program has allowed us to demonstrate the effectiveness of exercise as a powerful tool in improving the health and wellbeing of older people. Our organisation could not have delivered a program of this quality without the government support to create a model of care that bestows undeniable benefits. A model of care suitable for national dissemination.

Results obtained through participation in this program have wide-reaching implications. The benefit of adopting this program nationally would allow better management of personal disability, reduced aged care transition costs and increased dignity in later life. These are key priorities outlined by the World Health Organisation and the International Federation on Ageing, and align directly with Australian government priority areas of promoting and maintaining good health in older age. Already at Burnie Brae this program has become an integral part of our model of care. We look forward to seeing this program embraced nationally and to working together with government to build a healthier Australia.

Yours sincerely,



Kevin Rouse
Chief Executive Officer
Burnie Brae Ltd

EXECUTIVE SUMMARY

This report presents findings from the Muscling Up Against Disability program funded under the Commonwealth of Australia Department of Social Services Aged Care Service Improvement and Healthy Ageing Grant [Grant ID: 4-Z35FF5, awarded March 2015]. The primary purpose of this study was to implement and evaluate an evidence-based progressive resistance plus balance training program as a service delivery option for community-dwelling older adults with home care packages to reduce their trajectory of health decline, improve their wellbeing and prolong their independence. It was anticipated that the benefits of this 24-week, twice-weekly progressive resistance plus balance training program would be retained after the training period, making it a cost-effective program with long term benefits to the Australian health care system.

The Muscling Up Against Disability program was designed and delivered by accredited exercise physiologists experienced in working with old and very old individuals with aged care service needs. Program efficacy was assessed through changes in a broad spectrum of outcome measures in the domains of physical health, emotional wellbeing and overall quality of life.

Participants in this program realised significant physical health improvements:

- Leg strength improved by 33%
- Physical performance scores up by 13%
- Sarcopenia-risk summary scores improved by 23%
- Frailty status scores down by 7%

Improvements were not limited to physical health. Participants experienced significant reductions in anxiety and depression, improvements in cognition and balance confidence and improved overall quality of life scores. These benefits were also associated with reductions in health service access.

Importantly for this group, a cohort not commonly found in the gym environment, this modality of exercise has been embraced by participants. In fact, the demand for the program has been so great that it has resulted in the implementation of a similar sustainable exercise program at Burnie Brae.

The Muscling Up Against Disability program has important implications for individuals, providers and the government. For participants, this program offers an opportunity to improve their physical and mental health, and to prolong their independence. For providers, it offers an evidence-based program that can be embedded into their service delivery. For the government, improved health and wellbeing of participants translates directly into reduced spending on support services for ageing Australians.

POLICY POINTS

1. Development of a national progressive resistance plus balance training (PRBT) tool kit.

Evidence is undeniable that with participation in PRBT individuals can maintain health and prolong independence. Results from the Muscling Up Against Disability program demonstrate that this evidence can be translated into practice in a successful and sustainable manner.

Increasingly, older adults are turning to exercise to improve their health while, in parallel, growing numbers of aged care providers are looking to offer exercise within their model of care. The dissemination of the Muscling Up Against Disability program as a professional PRBT resource would allow a wider cross-section of the older population to achieve the health benefits experienced by our participants.

2. Government support for dissemination of a national PRBT tool kit.

Changing traditional models of care to evidence-based practice can be a slow process. While there is growing acknowledgment of academic research within the aged care sector, most research output aims to establish knowledge currency rather than looking at ways to integrate proven interventions into models of care. The government has significant capacity to improve this situation by supporting the dissemination of tried and tested programs to improve the health of the growing population of older people with aged care needs. The Muscling Up Against Disability program offers a reablement opportunity that can be modified to specific provider need and resource availability. However, this model of care needs to be brought to the aged care sector, rather than the sector being expected to come to it.

3. National support for improved models of care.

Current government funding schemes allow individuals to access some allied health and therapy services within their community as a part of their aged care packages. Nevertheless, many individuals continue on their trajectory of decline into poorer health and increasing care needs. However, results from the Muscling Up Against Disability program show that individuals can push back against physical and cognitive decline, independent of their age or initial health status. This suggests that current models of care, where disability continues to increase, are ineffective. Providers must be encouraged to ensure that the services they provide are effective and supported to implement better models of care.

RECOMMENDATIONS

That access to regular group-based progressive resistance plus balance training programs be subsidised for all Australians over the age of 65 years.

That these programs be delivered by allied health professionals, such as accredited exercise physiologists, who are experienced in exercise prescription for old and very old clients.

That programs be delivered from an evidence-based platform with national access supported by government to ensure the aged care sector can effectively translate evidence into good practice.

That aged care providers be supported in accessing evidence-based models of care, including being guided with transparent and accountable systems of assessment, to ensure programs deliver positive health outcomes.

BACKGROUND

Population ageing, an increase in disability and the prevalence of complex health conditions present many challenges for older Australians and places major stresses on the Australian healthcare system. When coupled with increasing intensive care service needs, and the growth of the population 85 years and over, projected health care expenditure will increase markedly in coming years. Projections to the year 2050 suggest that the demand for home assistance and residential aged care placement will more than treble [1, 2]. This will further increase the need for specialist and allied health service provision by professionals in this sector.

The declining health and increasing disability of older adults is closely related to their sedentary behaviour, which is an established precursor to losses in muscle mass, strength, mobility, physical performance and increasing falls risk [3]. These physical changes increase the risk of disability, cognitive impairment, institutionalisation and early mortality [4, 5]. This loss of independence significantly impacts the individual's quality of life and personal dignity. As a result, over one million older Australians receive home care services each year [2]. Progressive resistance plus balance training (PRBT) is a proven mode of training with benefits for all older adults that could substantially reduce the projected personal and healthcare impacts of increasing population disability [6].

Data to support this modality of training have been growing within research for more than 30 years, with current evidence suggesting benefits of significant proportion. However, in contrast to the commonly delivered, low intensity, irregular participation type interventions, PRBT comprising 3 sets of 8 – 12 repetitions of exercises, performed twice-weekly or more, that employs the overload principle is shown to not only be safe but to have the most consistent positive benefit for older people. In addition, to increase static and dynamic balance, as well as functional capacity and muscle strength, current recommendations support that participants receive a minimum of 50 hours of training, delivered regularly, in an ongoing manner, with programs incorporating targeted balance and muscle strength exercises, and that programs be delivered by highly skilled allied health professionals such as accredited exercise physiologists [7, 8].

PRBT is a powerful mode of exercise that produces a plethora of significant muscle physiology and health benefits. It is the only exercise mode shown to reduce many of the adverse effects associated to normal ageing, including the reduction in physical disability and chronic diseases such as diabetes, osteoporosis and osteoarthritis, all of which are known accelerants of aged care service need [9]. Yet, while evidence is strong and the benefits for old and very old adults are consistently demonstrated, PRBT continues to be a most underutilised tool in the battle against disability in later life.



Progressive resistance plus balance training is a powerful tool in combating later life disability.

PROJECT OVERVIEW

PRBT is a powerful tool in the battle against later life disability. With regular and ongoing PRBT older adults can reduce their decline into dependency and disability. This has important implications for an individual's dignity and quality of life, and for the national healthcare budget.

The primary purpose of this study was to evaluate an evidence-based PRBT as a service delivery option for community-dwelling older adults with home care packages to reduce their trajectory of health decline, improve their wellbeing and prolong their independence. It was anticipated that the benefits of this 24-week, twice-weekly PRBT program would be retained after the training period, making it a cost-effective program with long term benefits to the Australian health care system.

The project recruited 245 adults aged 65 years and older who were resident on the north side of Brisbane and who were receiving some form of government home care assistance. Participants were attracted to the project through personal letters from the CEO of Burnie Brae, via information seminars, carer contact, media advertising and by word of mouth.

Prospective participants contacted the project's research manager and were interviewed to determine eligibility and availability. They were then scheduled for a baseline assessment and transport was arranged (where requested) to and from the centre. Apart from age and service requirements, eligibility was based primarily on clients not currently participating in any strength building exercise, being able to follow instruction and being able to transfer in and out of transport with the assistance of only one person.

Following baseline assessment participants were randomised to either the twice-weekly PRBT intervention or to a usual care wait list control group. The wait list control group received the exercise program after a waiting period of 24 weeks.

Physical assessments and training sessions were designed and supervised by accredited exercise physiologists with expertise in exercise for older people and those with a disability. The exercise program consisted of two one-hour sessions each week (separated by at least one day) for 24 weeks.

Data were collected at the baseline assessment and again following the 24-week exercise program (or at the end of the wait list period) and again at 24 weeks post-exercise intervention so that the residual impact of training could be evaluated. The data collected included client physical outcomes (strength and balance measures), psychosocial and quality of life measures and health system usage. Interviews were also conducted with participants during this time to form the basis of a qualitative assessment of the program. Project implementation costs were also recorded.

Project outcomes hold significant promise for older Australians with government supported aged care packages. In brief, participation in PRBT training led to measurable increase in muscle strength and physical capacities that were complimented by reduced anxiety, depression and health service access. These positive gains support that participation has significant implications for minimising the development of disability and for prolonging independent living. In addition, personal testimonials and attendance data support this form of training as acceptable among these older participants.

The Muscling Up Against Disability program has important implications for individuals, providers and the government. For participants, this project offers an opportunity to prolong their physical independence and improve their mental health. For providers, it offers an evidence-based program that can be embedded into their service delivery. For the government, improved health and wellbeing of participants translates directly into reduced spending on support for ageing Australians.

PROJECT TEAM

The project employed a partnership between Burnie Brae, Dr Tim Henwood, The University of Queensland, Bond University, St Vincent's Care Services and HUR Australia. During the course of the project St Vincent's became less involved and the original research manager, Brent Hodgkinson, moved into another role. However, all remaining parties continue to work on and advocate for the Muscling Up Against Disability program including the new research manager, Dr Sharon Hetherington.

Researchers

Dr Timothy Henwood

Group Manager, Connected Living – Community Wellness and Lifestyle, Southern Cross Care SA &NT, is the project research lead. His greater than 80 peer reviewed and sector publications, books and book chapters and a government report emphasizes the importance of progressive resistant training and weight bearing exercise to promote later life wellbeing and prolong independence. His research has informed many ongoing community, respite and residential aged care programs, and is currently being translated to evidence in Southern Cross Care community and residence aged care health ageing model.

Dr Justin Keogh

Bond University, Faculty of Health Sciences and Medicine, is a leading exercise scientist whose research focuses on ageing and chronic disease related disability in later life, and using progressive resistance training as a countermeasure to these. As a consequence of his work in this area, he has been appointed a fellow of the Australian Association of Gerontology in 2012. He has published ~150 peer reviewed journal articles, and according to Scopus statistics has an H-index of 26 and a total of 2066 citations. He has also obtained ~ \$2M in external research funding.

Dr Paul Gardiner

UQ Centre for Health Services Research, Faculty of Medicine, is an experienced epidemiologist, and a recognised expert in the health behaviours and programs to promote healthy lifestyles among older adults and people with chronic conditions. He has 53 peer-reviewed publications, 1814 citations, an H-index of 18 (Scopus 30/10/2017) and received over \$2.6 million in project funding in Australia, USA and Canada. He is the President of the Queensland Branch of the Public Health Association of Australia and founder and co-chair of the Ageing Special Interest Group of the International Society of Behavioral Nutrition and Physical Activity.

Dr Anthony G Tuckett

UQ School of Nursing, Midwifery & Social Work, Faculty of Health and Behavioural Sciences, is a qualitative and evaluation researcher who undertakes health services research. He is interested in how social factors, organizational structures and processes, health technologies, and personal behaviors affect health care and the quality of health care, and ultimately health and wellbeing. Health services research domains are individuals, families, organizations, institutions, communities, and populations. Anthony is particularly interested in population ageing and the role that older people as citizen scientists can play in changing their world.

Dr Sharon Hetherington

Research Manager, Muscling Up Against Disability, Burnie Brae. Dr Hetherington is an accredited exercise physiologist whose research focus is on barriers and motivations to exercise for older people. She has extensive industry experience promoting and supporting the work of exercise physiologists in the field of ageing and aged care.

INDUSTRY PARTNERS

Burnie Brae Ltd

Burnie Brae is a not-for-profit, incorporated organisation which opened in Chermside (Brisbane, Australia) in March, 1984. It is Queensland's largest over 50's community centre, and delivers across four locations on the north side of Brisbane a wide range of unfunded social, educational and recreational activities to its membership. Additionally, the organisation auspices a range of government funded community services for seniors, frail aged persons and younger people with disabilities, managed by a team of dedicated professionals striving to provide the highest possible standard of service to clients and their families. Burnie Brae has successfully grown and developed to be a leader in quality care services for seniors and people with disabilities.

Burnie Brae employs 120 staff, has a membership of over 6000 and provides personal, health and social services to more than 10 000 recipients across Brisbane's north. Burnie Brae CEO, Kevin Rouse, passionately led the project steering committee through the course of the study and continues to interact on coming publications and data analysis.

Burnie Brae serves as a gathering place for its membership where they can engage in a variety of activities on any one day. For example, members may attend a Pilates class, catch up with friends for a coffee, attend a session at the Health Connections Exercise Clinic, then see the on-site podiatrist. In addition, dance-based and indoor physical activities, education seminars, hairdressing and a library, are available on-site. Up to 15 off-site tours are also available each month. This unique environment has a strong reputation, not only as a meeting place but as a location where older adults can be supported in improving their health and wellbeing.

Healthy Connections Exercise Clinic

Healthy Connections Exercise Clinic is a wholly owned subsidiary of Burnie Brae. The clinic is a purpose-built facility catering exclusively for the health and fitness needs of people over 50. Recognised as the Exercise Physiology Clinic of the Year in 2015, Health Connections Exercise Clinic specialises in exercise delivery tailored for old and very old clients, many of whom receive aged care funding packages.

The clinic receives large numbers of general practice and My Aged Care referrals due to its strong track record of helping clients to improve their health and maintain their independence. In addition to running the Muscling Up Against Disability program the clinic also offers cardiac rehabilitation classes, programs for people with physical and intellectual disabilities, falls prevention programs and programs aimed at maximising brain health and cognitive function.

Healthy Connections Exercise Clinic features the usual array of gymnasium equipment such as treadmills, upright and recumbent bikes, hand cranks, rowers and pin weighted machines. In addition to this traditional equipment Healthy Connections Exercise Clinic also has three sets of pneumatic resistance exercise equipment designed and built by HUR (HUR Labs Oy, Tampere, Finland) especially for ease and safety of use by older people.

To ensure participants received the required level of attention, the Muscling Up Against Disability program employed a dedicated space within the Healthy Connections Exercise Clinic. This also allowed for better management of the high level of participant traffic experienced during the final phases of delivery without unduly disturbing the normal running of the Healthy Connections Exercise Clinic.

INDUSTRY PARTNERS

HUR Australia

A subsidiary of the world's leading supplier of exercise equipment for retirement communities and senior exercise facilities (HUR International). HUR worked closely with the study team and in support of the project. HUR equipment was used exclusively during the Muscling Up Against Disability program because of the ease of access and ease of use for older people with mobility difficulties. HUR equipment makes use of 'smart technology' where all the equipment is networked and individual exercise progressions can be programmed by the exercise physiologist from a centralised computer system. This meant that participants do not need to remember sets and repetitions nor weight settings for each exercise. Users had a swipe card that logged them in to each piece of equipment and allowed their exercise patterns to be tracked centrally.



HUR equipment layout in the Healthy Connections Exercise Clinic.

PARTICIPANTS

Recruitment

Community-dwelling older Australians receiving government-funded in-home care packages were recruited to participate in a resistance plus balance training intervention. All participants were recruited from the membership database of Burnie Brae (N>6000) that offered, among a suite of other services, aged care support. Pathways of recruitment included information sessions, organisational advertising and a letter sent directly to a random selection of the organisation's members who were receiving in-home services addressed to the potential participant. In the letter, signed by the CEO of Burnie Brae, the study was described and an expression of interest was sought from the recipient. Potential participants then contacted the project's research manager by telephone and undertook a brief interview to determine eligibility and the study was outlined in more detail. Eligible participants were forwarded a study pack containing the participant information sheet, a consent form and a health history questionnaire. Eligible participants were also scheduled to attend the exercise clinic for baseline assessment. The study timeline and recruitment detail is shown in Figure 1.

Eligibility criteria

(a) over 65 years of age, (b) community-dwelling, (c) with an Australian government aged care package, (d) mobile with or without an aid, (e) able to follow instructions and commit to the study period, and (f) with no recent history of resistance training.

Exclusion criteria

(a) requiring more than one person to assist with transfers, standing and/or mobilising, (b) medications and/or diseases with contraindications for exercise, (c) terminal illness or receiving palliative care, (d) an imminent move to residential care, (e) difficult behaviours and (f) inability to obtain a doctor's consent to participate.

GP consent

The participant's doctor was forwarded a study brief, identifying the individual's intention to participate in the study and requesting they contact the research manager if they had any concerns.

Transport

To overcome the barrier of getting to and from exercise, all participants were offered transport at no cost as part of the study. Transport was supplied by the Burnie Brae transport service and scheduled weekly by the research manager to bring participants to the clinic for exercise and assessments and to return them home afterwards.

Assessments

Baseline assessments were conducted in the same clinic in which the training occurred. Following the baseline assessment, participants were randomised by the research manager to exercise (EX) or wait list control (CON) at a ratio of 1:2 using block randomisation through a sealed envelope selection method. The project employed a modified stepped-wedge randomisation to ensure all participants were allowed the opportunity to benefit from the exercise intervention.

Ethics and trial registration

The study design and delivery methodology have been described in greater detail previously [10]. 245 participants were recruited into the study and randomised over four waves to EX (N = 86) or CON (N = 159). Ethics approval was obtained from the University of Queensland Human Research Ethic Committee (Approval number #2015000879) and the study was registered with the Australian New Zealand Clinical Trials Registry (ACTRN12615001153505).

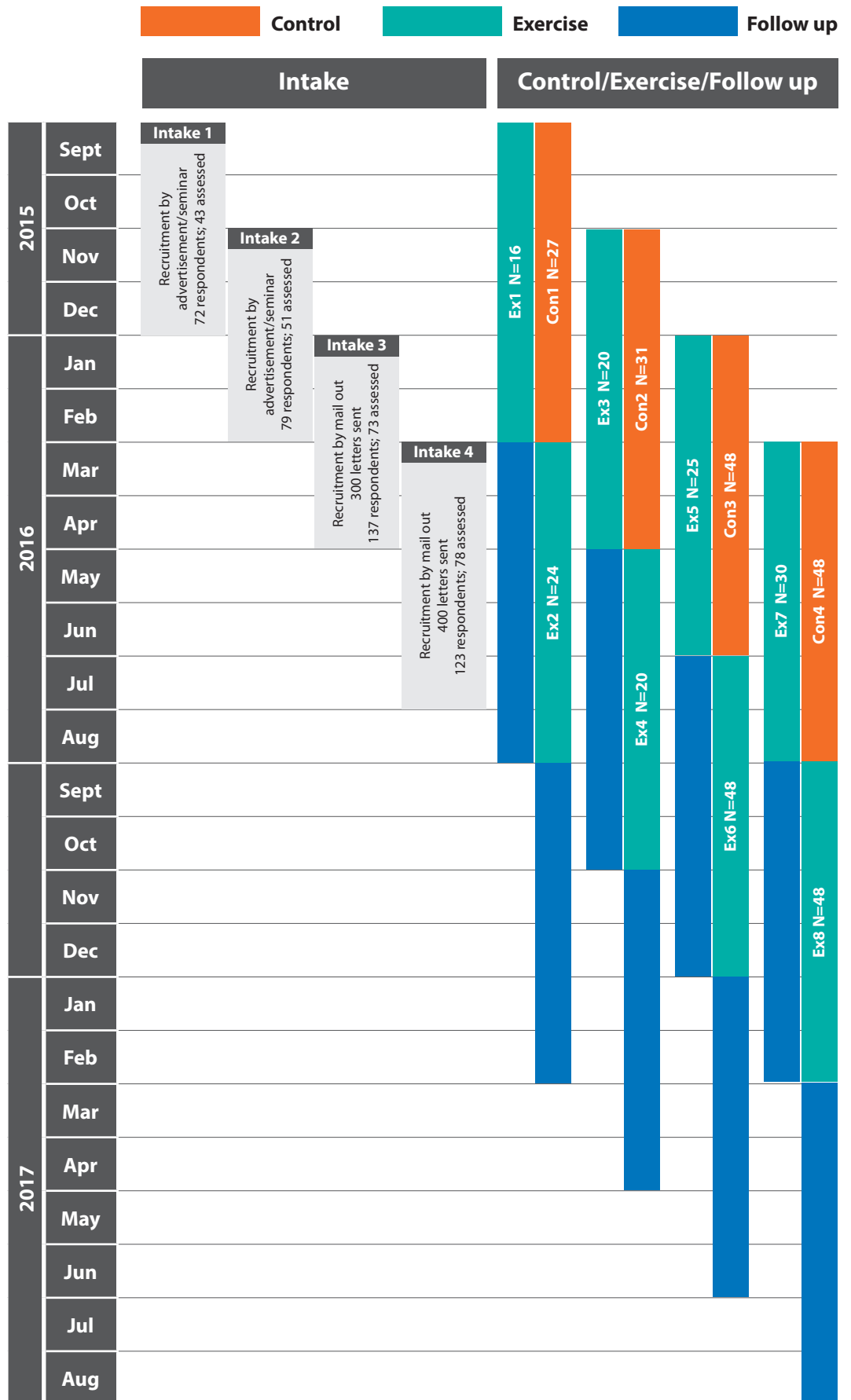


Figure 1 - Study timeline showing the recruitment and randomisation

INTERVENTION

Participants undertook 24 weeks of twice-weekly PRBT in a clinic space reserved specifically for this study. Participants were supervised by exercise physiologists experienced in exercise delivery for older adults with complex healthcare needs.

Session structure

Sessions included a light five-minute warm-up, generally based around walking, followed by 45 minutes of machine-based resistance training and targeted balance exercises. Exercise sessions concluded with a 5 minute cool down incorporating stretching. Resistance exercises were performed on the air-pressure driven computer-integrated HUR equipment. The PRBT regime was an evidence-based program designed by experienced exercise physiologists [8, 11].

Resistance exercises

(1) Chest press, (2) Back row, (3) Leg press, (4) Leg curl, (5) Leg extension, (7) Leg abduction, (8) Leg adduction, and (9) Abdominal crunch. These exercises were performed on the HUR equipment. Following a conditioning phase, exercises were performed in 3 sets of 8–12 repetitions, with resistance set at a moderate to high intensity (approximately 75% of the estimated 1 repetition maximum (1RM)).

At baseline, participants' grip strength informed the starting resistance for each exercise. Participants with below average grip strength (men < 30 kg and women < 20 kg) were given a lower, more conservative starting resistance.

The 24-week period commenced with a four-week conditioning phase to ensure technique development and to reduce training-related delayed onset muscle soreness. Specifically, 2 sets of 8 repetitions for each exercise were completed for the first two weeks at a low resistance (~ 50% estimate 1RM) and 3 sets of 8 repetitions at an increased resistance (~65% estimated 1RM) for the subsequent 2 weeks.

In the fifth week, the resistance was increased to approximately 75% of estimated 1RM. From this point exercise resistance was increased by half a kilogram when participants successfully completed the 3 sets of 12 repetitions [11].

Balance training

(1) Single leg stand - 2 sets aiming for 20 seconds on each leg, (2) Tight rope walking - 2 sets of 10 steps forward and 10 steps back, (3) Box stepping - 5 times clockwise and 5 times anticlockwise and (4) Calf raises—2 sets of 10. The same four-week conditioning phase was implemented with the balance exercises, commencing with reduced repetitions or time per exercise and with support for balance. In the fifth week, participants progressed to the full balance program and reduced their reliance on balance support.

Participants were encouraged to work towards completing the balance exercises without support where possible. With supervision by trained exercise professionals, PRBT has been employed safely and effectively in similar populations [11, 12].

Session delivery

All sessions were delivered in small groups, up to a maximum of 10 participants, under the supervision of exercise physiologists who offered support and motivation. Groups of five or less were supervised by one exercise physiologist, groups of more than five participants were supervised by two exercise physiologists. If participants experienced pain or discomfort when performing any of the prescribed exercises, the exercise in question was modified, and if this did not alleviate the issue, the exercise was removed from that participant's program.

Control group activities

Control participants were asked to continue with their usual activities for a 24-week period, during which time there were no activity restrictions, but there was a request to not enter into any ongoing (> 4 weeks) exercise programs. To incentivise continued participation, individuals received a monthly education session and morning tea at Burnie Brae. Sessions lasted approximately one hour and covered topics including nutrition, sedentary behaviour, exercise, chronic disease and assistive devices. Session dates and details appear in Appendix 2. Following the completion of the 24-week control phase, all control participants entered the exercise phase as described above.

OUTCOME MEASURES

Quantitative assessments

Health history data were collected at baseline by questionnaire (sex, marital status, smoking history, level of education, socioeconomic background, exercise history and medical history - including comorbidities and number and type of medications, hospitalisations in the past 12 months, falls in the past six weeks, living, support and care status, and frequency of GP and specialist visit in the past six weeks). Where data were missing, the client was questioned directly. Participants completed a daily diary throughout the study period. Diary entries collected data on health system utilisation, activity, falls and sleep. Diaries were managed and monitored by the research manager.

Bioelectrical impedance analysis (BIA) (Maltron BF-906, Maltron International Ltd, Rayleigh, UK) was used to estimate volume of fat and lean body mass during supine rest. Muscle mass was calculated from a validated BIA equation [13]. BIA is quick to sample, non-invasive, and is an extensively validated and accurate measure of muscle mass across all age groups [14].

Hand grip muscle strength was measured using an isometric Jamar dynamometer (Sammons Preston Roylean, Bolingbrook, IL). Grip strength has been correlated with lower extremity muscle power, knee extension torque and calf cross-sectional muscle area. Three trials of the dominant hand are conducted, with the best measure kept for analysis [15].

Isometric leg extension strength was measured during physical assessments for all participants and fortnightly during training for individuals in the exercise phase. Measurement was by a 0 to 500-kilogram strain gauge HUR Performance Recorder (HUR Labs Oy, Tampere, Finland) that was fitted to the leg extension machine. With the lever arm locked at 45° the participant pushes against the lever arm with maximum force. Participants were given two trials and the best result was used for analysis.

Physical performance was measured by gait speed, and all three objective self-explanatory Short Physical Performance Battery (SPPB) measures collected [16, 17]. The SPPB includes: three hierarchical tests of standing balance, a timed 4 metre walk and 5-time repeated chair stands. Measures were collected as per the Guralnik et al. [17] protocol, and were analysed as independent measures and combined into a summary score. The SPPB is a known predictor for loss of mobility, hospitalisation, institutionalisation and mortality [16, 17].

Sarcopenia is defined as a combination of low muscle mass and low muscle function (muscle strength and/or physical performance). In this study, muscle mass was measured by BIA, muscle strength by hand grip strength, and physical performance by the 4 metre walk speed test [14, 18]. The established cut-off points to define low muscle mass are ≥ 2 standard deviations below the norm of a young healthy population (< 8.87 kg/m² for men and < 6.42 kg/m² for women), for low muscle strength < 30 and < 20 kg for men and women, respectively, and low physical performance via a gait speed of < 0.8 m/s [14].

In addition to the physical assessment of sarcopenia, the SARC-F questionnaire [19] was completed by participants as a test of the SARC-F's validity in the target population and in an Australian context. The FRAIL scale [20] was also completed to investigate frailty status, and to explore relationships between questionnaire-generated sarcopenia and frailty status.

OUTCOME MEASURES

Mental health was assessed using the Mini-Mental State Examination (MMSE) [21]. The Geriatric Depression Scale – Short Form (GDS) was used to evaluate level of depression [22] and the Geriatric Anxiety Inventory (GAI) to evaluate level of anxiety [23]. Mental health was also discussed during the interviews for the qualitative assessment.

From the MMSE, participants were classified as having normal cognition (25–30), mild (21–24), moderate (14–20) or severe (<13) cognitive impairment based on their summary score. From the GDS, participants were classified as being without depression (normal (0–4)), or having mild depression (5–8), moderate depression (9–11) or severe depression (12–15) based on their summary score. For anxiety, participants scoring less than 9 in the GAI have an absence of clinical anxiety, those scoring 9 or more have a presence of clinical anxiety.

Nutritional status was measured using the Mini-Nutritional Assessment Instrument® (MNA®). The MNA® has four components (anthropometric, and a global, dietary, and subjective assessment), and is internationally recommended as a nutrition assessment tool in nursing care [24, 25]. Participants were defined as having normal nutritional status (12 – 14), at risk of malnutrition (8 - 11) or malnourished (0 - 7).

Falls were self-reported in the health history questionnaire and diarised (daily diaries) over the course of the project. In addition, the Activity-Specific Balance Confidence (ABC) questionnaires was used to assess falls self-efficacy in participants. The ABC valid for total falls risk and can distinguish between fallers and non-fallers [26, 27]. A fall was defined as an event resulting in a person coming to rest unintentionally on the ground or lower level, not as a result of a major intrinsic event (such as a stroke) or an overwhelming hazard [28]. Participants were also asked about falls during interviews for the qualitative assessment

Sleep hours were collected by self-reported daily dairy and were inclusive of nap times [29]. Achieving between 7 – 9 house sleep in a 24 hour period was considered optimal sleep [30]. Sleep patterns were also discussed during interviews for the qualitative assessment.

Quality of Life was measured using the EuroQoL EQ-5D-3L to assess participant health related quality of life and to calculate quality adjusted life years (QALYs).

This EQ-5D-3L is a valid and accurate measure of health related quality of life which provides a single index value between 1 (perfect health) and 0 (death) [31]. It consists of two sections: The first section asks participants to select the response that best describes their health state today from 3 possible statements varying in severity within each of five domains (mobility, self-care, usual activities, pain/discomfort, and anxiety depression). This provides for 243 possible health states. The second section asks the participant to rate their perceived health state today on a Visual Analogue Scale where 100 is the best and 0 is the worst possible imagined health state. The utility index value is determined using an algorithm that incorporates scores from each domain response and Utility weights derived from a representative population. Specific utility weights for the EQ-5D-3L are available for Australia [32].

OUTCOME MEASURES

Qualitative assessments

Qualitative data collection occurred during the intervention for those who did not start and did not finish the exercise program, and post-intervention for those who did finish the exercise program. Data were also collected post-intervention from exercise physiologists and Burnie Brae transport drivers involved in the project.

Participants

Semi-structured telephone interviews were conducted with Muscling Up Against Disability participants. These interviews were conducted in order to address multiple questions. Firstly, to examine participants' perceptions of barriers to, and facilitators of, the program. Secondly, to gain an understanding of the PRBT intervention and the care model within which it was delivered in terms of its acceptance, feasibility and sustainability. Finally, participants who completed the exercise program were asked about their experience of falls, their sleep patterns and general mental health in the context of the effect of the intervention.

All interviews were led by an experienced qualitative researcher sensitive to the target population and followed a semi-structured script. Interviews were recorded relying on in situ notetaking followed by a detailed transcription immediately after completing each telephone interview.

Exercise physiologists and transport drivers

Separate focus groups were conducted on location at Burnie Brae with the exercise physiologists and transport drivers involved with the Muscling Up Against Disability program. Exercise physiologists also completed a small diary 7 days before and 7 days after the focus group interview. Focus groups were digitally recorded and notations were made by the qualitative researcher. Focus group recordings and diaries were transcribed verbatim.



Accredited exercise physiologists guided participants through all aspects of the program.

OUTCOME MEASURES

Attendance and adverse events

Attendance

Participants' exercise session attendance records formed part of the sustainability analysis. In order to access the HUR machines and their prescribed exercise program, the participants were required to "swipe on" using their personalised exercise card prior to use. This data allowed quantification of attendance as well as compliance to the exercise prescription. This information was then matched against session data recorded by the research manager to allow for the reason for not attending to be recorded and to ascertain whether the participant was able to make up the missed session during the same week.



The HUR swipe card system allowed central monitoring of participant attendance and progress.

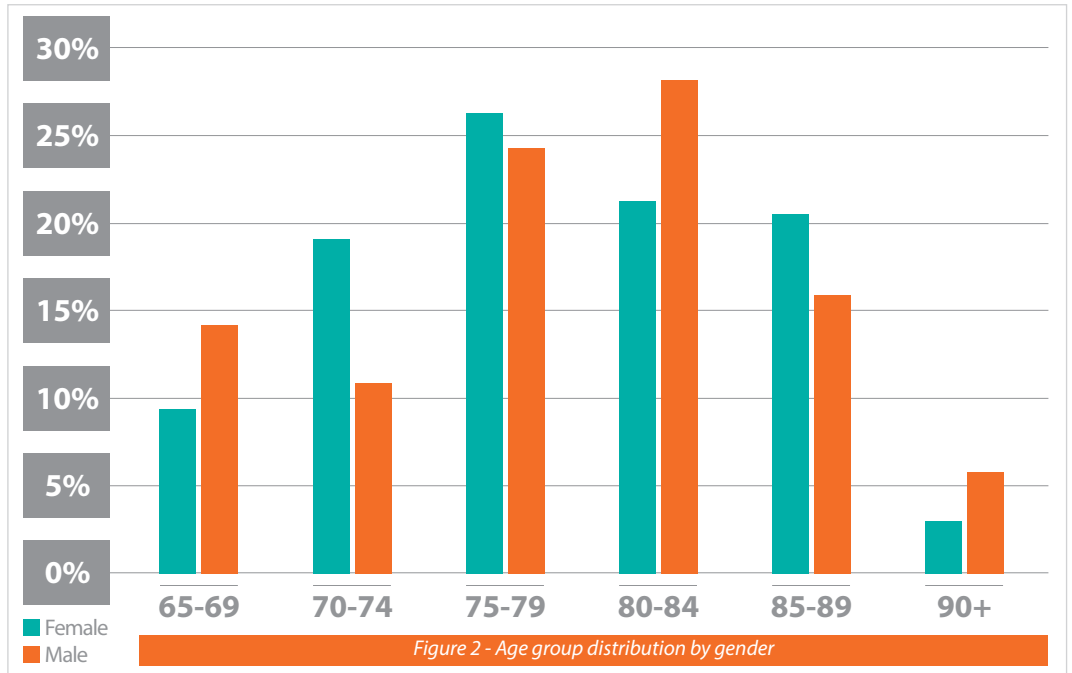
Adverse events

Participants were asked to note any adverse events that occurred during their participation and to notify the research manager about these at the earliest convenience. Adverse events were categorised on the basis of when they occurred (during exercise or assessment sessions, including travel to and from the Burnie Brae centres or during incidental activities) as well as their severity, using a five point scale [33]. The research manager or supervising exercise physiologist (for adverse events that occurred during exercise or assessment sessions) provided advice to the participant regarding referral to a physician or allied health professional. If a participant was absent from one assessment session, or from two or more consecutively scheduled training sessions, the research manager contacted them to ensure the absence was not due to any adverse event. During the exercise and assessment sessions, the exercise physiologists also routinely asked the participants whether they had experienced any adverse events.

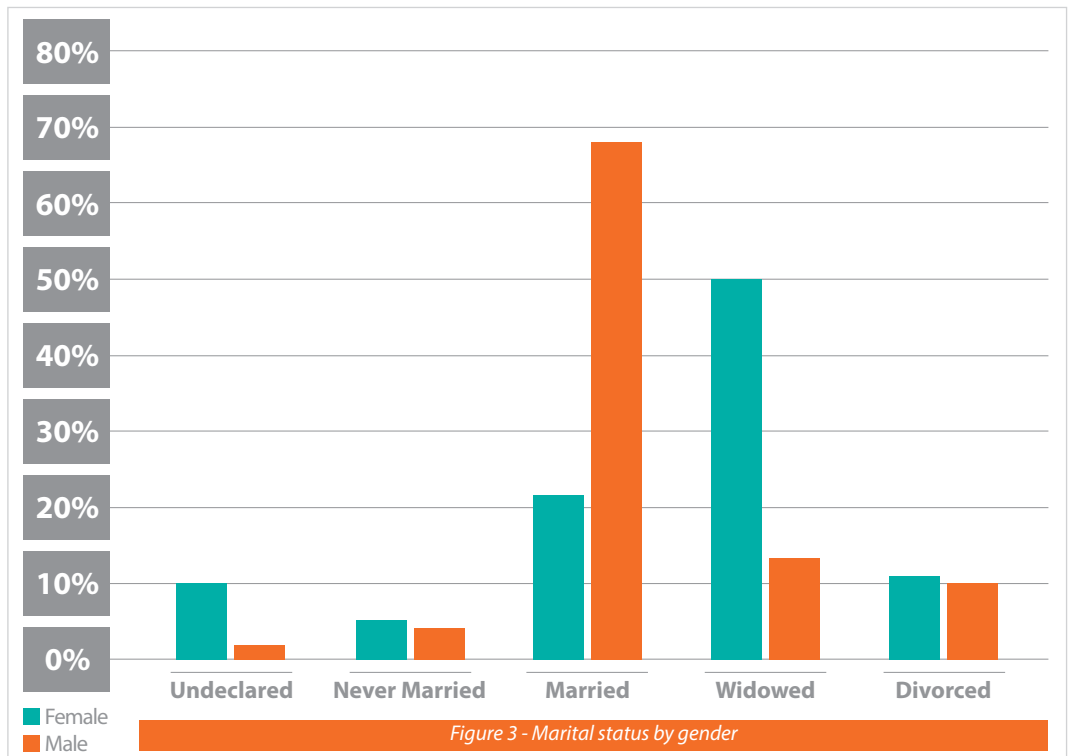
FINDINGS

Demographic data

The majority of participants in the Muscling Up Against Disability program were female (80% female vs 20% male). The average age of participants entering the program was 78.7 ± 6.5 years. Age group distribution of participants is shown in Figure 2.

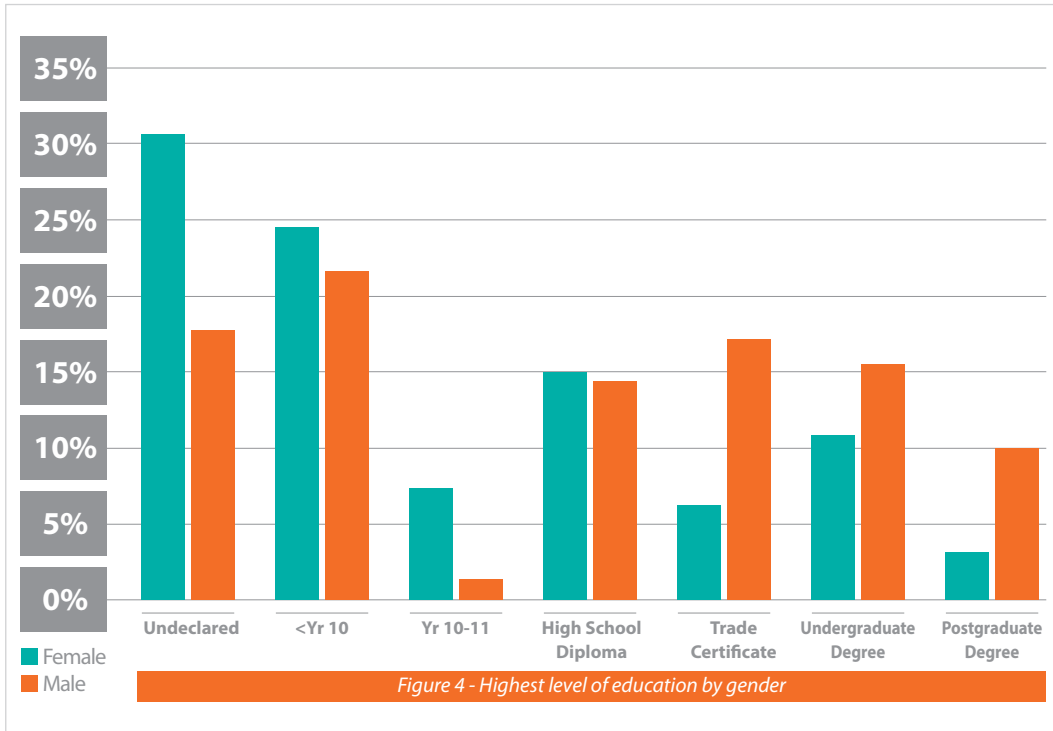


Majority marital status for female participants was widowed and for male participants was married (see Figure 3).

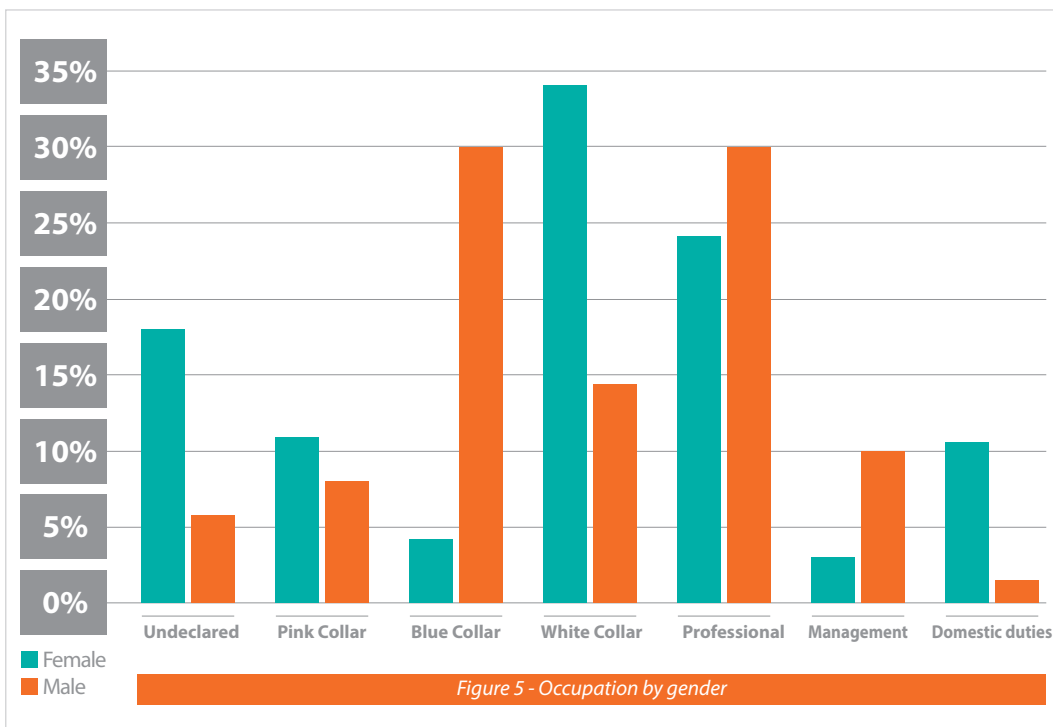


FINDINGS

Males in the study population tended to have higher levels of educational achievement than females as shown in Figure 4.



The range of occupations by gender were broadly distributed between categories; however, males were more likely than females to work in blue collar occupations (see Figure 5 for details).



FINDINGS

Outcome measures data

Data for the entire cohort on entry to the study are shown in Table 1. The following significant differences were found on analysis between females and males. Males had, on average, higher body mass than females, a greater proportion of lean muscle mass, performed better on the physical performance battery, were stronger (leg and grip strength) and less frail. Males also scored lower on the anxiety index and had better balance confidence than females on entry to the study. There were no significant differences detected between females and males on the remaining outcome measures.

Table 1 - Outcome measures by gender for cohort on entry to the study

	Females (n=195)	Males (n=50)	Whole Cohort (n=245)
Age (years)	78.6	78.8	78.7
Morbidities (n)	5.2	4.5	5.0
Medications (n)	5.4	4.6	5.2
Body mass (kg)	74.2	82.7*	75.9
BMI	29.6	28.9	29.4
Lean mass (%)	58.9	70.3*	61.1
SPPB	7.8	8.9*	8.0
Leg strength (kg)	56.7	91.1*	63.8
Grip strength (kg)	19.5	30.5*	21.7
SARC-F	2.9	2.3	2.8
FRAIL	1.9	1.3*	1.8
EQ 5D 3L	0.76	0.84	0.78
GAI	4.1	3.7*	4.0
GDS	3.0	3.4	3.1
MNA	12.8	12.5	12.7
MMSE	28.2	28.0	28.2
ABC	58.6	68.8*	60.7

*indicates statistical significance at $p < .05$

n – number, % – per cent, kg – kilograms, SPPB – Short Physical Performance Battery summary score, EQ 5D 3L – EuroQoL 5D 3L, GAI – Geriatric anxiety index, GDS – Geriatric depression scale, MNA – Mini nutritional assessment, MMSE – Mini mental state examination, ABC – Activities-specific balance confidence scale

FINDINGS

Retention and attendance

- 245 participants were randomised to either wait list control group (159) or exercise group (86).
- 30 participants withdrew prior to starting the exercise intervention - Did not start (DNS) group.
- 47 participants withdrew during the exercise intervention - Did not finish (DNF) group.
- 168 participants completed the exercise intervention – Finished (FIN) group.

Reasons provided by participants for not starting or not finishing the exercise intervention are summarised in Table 2 and Table 3. The retention rate for the project overall was 69% and the retention rate once participants entered the exercise intervention was 78%. Those who started but did not complete the exercise intervention attended, on average, 31% of the 48 sessions. Those who completed the exercise intervention attended, on average, 90% of the 48 sessions.

Table 2 - Reason recorded for withdrawal - DNS group

Reason recorded	Percentage
No explanation provided	40%
Illness which prevented them from continuing	30%
Hospitalised and unable to continue in study	10%
Too busy to fit in the exercise sessions	7%
Unhappy at being randomised to the wait list therefore not continuing	7%
Death	3%
Moved out of the area	3%

Table 3 - Reason recorded for withdrawal - DNF group

Reason recorded	Percentage
No explanation provided	42%
Illness which prevented them from continuing to exercises	42%
Found the exercise sessions too much to cope with	6%

FINDINGS

Qualitative feedback on reasons for non-completion

More details emerged during interviews conducted with individual participants for the qualitative assessment with those who did not start (DNS) and did not finish (DNF) the exercise intervention.

DNS – Illness or hospitalised

With the duration between first contact and receipt of paperwork, CVs “health issues” continuum changed. In the “gap” CV was hospitalised and “could not cope – too much forms”.

LG was unable to evaluate exercise and Muscling Up Against Disability program as useful. Restricted in his mobility generally and “got worse last 3-4 weeks”. “Difficult to get around even with transport”.

JD reported being extremely upset and “mixed up” and simply not well enough to focus on what was required.

DNS – Too busy

For DE this is a “busy time of the year ... not a lot of time ... too close to Christmas” – so engaging with the new project would add to what she is already managing.

VF perceives that the Muscling Up Against Disability program “is fairly time consuming ... don’t know if I’ve got that time”. Probing could not reveal why she was time restricted other than not having time to dedicate to the exercise task.

DNF - Illness

Her current altered health (aortic aneurism/stent/“leaking”) means SB is “unable to do arm raising or such”. SB’s doctor has advised her “to do nothing” including gardening.

DNF – Too much

RW completed up to 5 weeks of Muscling Up Against Disability program but “under Dr’s instructions” stopped. Concern raised about her hip (inner quad exercise) though a physiotherapist and X-ray revealed nothing. RW “did enjoy (Muscling Up Against Disability program)” and “wanted to continue”.

Group differences at baseline

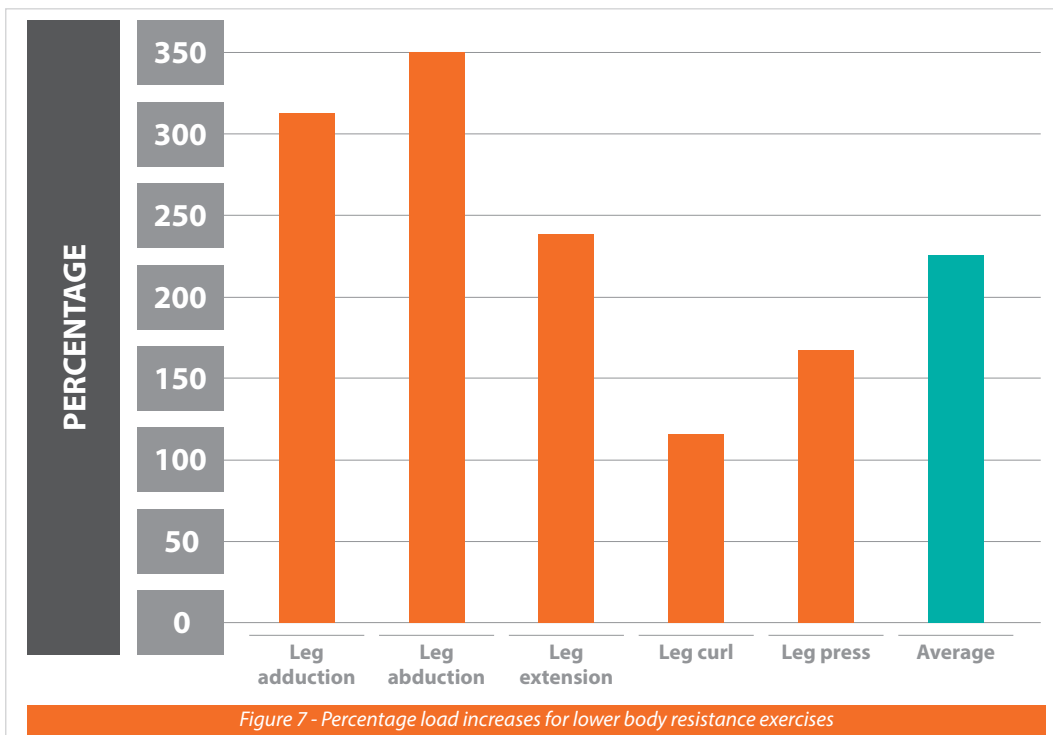
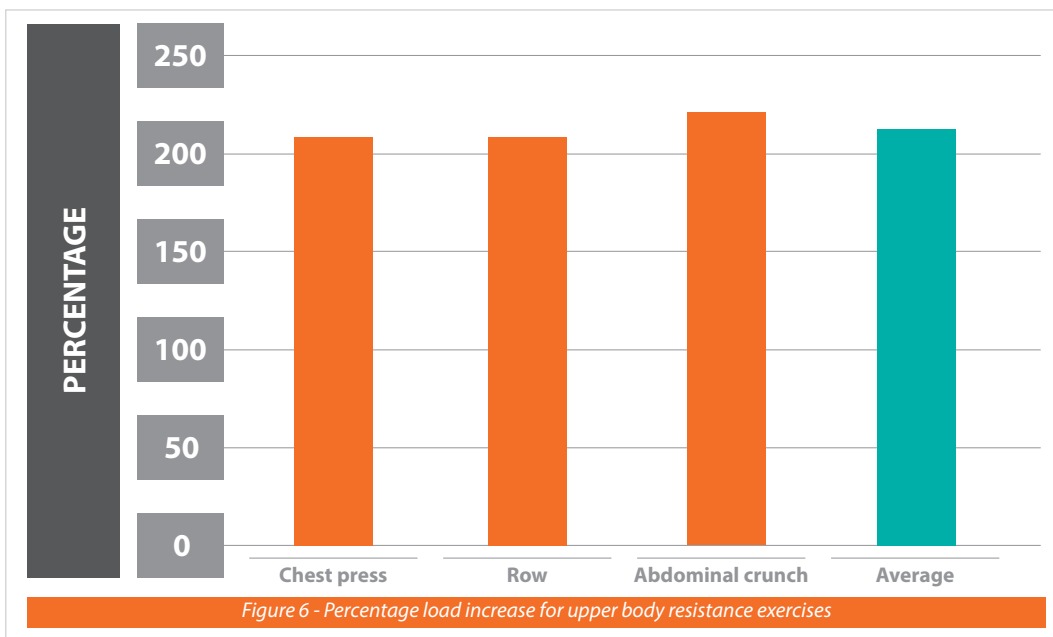
Analysis of differences between the DNS, DNF and FIN groups showed that, on average, those in the DNS and DNF groups had lower SPPB scores, slower walking speed and less chair stand capacity than those in the FIN group. Those in the DNS group also had lower grip strength and leg strength than those in the FIN group and lower balance ability than the DNF and FIN groups. The DNF group had more morbidities than the DNS and FIN groups. Details of this analysis are presented in Appendix 1.

FINDINGS

HUR equipment loading

Across the 48 exercise sessions, the resistance loading of the HUR equipment was increased incrementally. This was achieved using the computer interface with the equipment. After initially setting the starting load for each exercise based on the participant's strength at baseline, the system was programmed to automatically increase the resistance by half a kilogram when the participant successfully completed 3 sets of 12 repetitions of an exercise.

Changes in load were logged by the computer interface and mean percentage increases were calculated across the cohort during the exercise phase. Percentage load increase on HUR equipment across the exercise intervention are presented in Figure 6 and Figure 7.



FINDINGS

Change in outcome measures

Changes in outcome measures are presented in Table 4. The exercise group experienced significant improvements in SPPB score (+13%) and leg strength (+33%) and improved performance on the SARC-F which measures sarcopenia risk profile (-23%). Grip strength was maintained in the exercise group but deteriorated significantly in the control group (-13%).

Control group members experienced a significant improvement in their anxiety risk score while on the wait list to begin the exercise intervention (-22%). Exercise group members had significant improvements in quality of life (+5%) and depression risk score (-14%) as well as improved nutrition status (-2%), cognition (=1%) and balance confidence (+5%) as a result of participating in the exercise intervention.

Table 4 - Changes in outcome measures by intervention group

	Exercise (n=168)		Control (n=101)	
	Pre	Post	Pre	Post
Body mass (kg)	76.9	76.4	75.5	75.8
BMI	29.5	29.3	29.1	29.1
Lean mass (%)	61.3	61.9	61.5	62.2
SPPB	8.6	9.7*	8.3	8.3
Leg strength (kg)	67.8	90.5*	64.7	67.3
Grip strength (kg)	20.9	21.2	22.4	19.4*
SARC-F	2.6	2.0*	2.4	2.7
FRAIL	1.5	1.4	1.6	1.6
EQ 5D 3L	0.79	0.83*	0.78	0.78
GAI	3.4	3.0	4.1	3.2
GDS	2.8	2.4*	3.3	2.9
MNA	13.2	12.9*	12.8	13.1
MMSE	28.4	28.7*	28.3	28.4
ABC	65.4	68.6*	NA	NA

*indicates statistical significance at $p < .05$

n – number, % – per cent, kg – kilograms, SPPB – Short Physical Performance Battery summary score, EQ 5D 3L – EuroQoL 5D 3L, GAI – Geriatric anxiety index, GDS – Geriatric depression scale, MNA – Mini nutritional assessment, MMSE – Mini mental state examination, ABC – Activities-specific balance confidence scale

FINDINGS

Qualitative findings

The aim of this qualitative phase was to examine perceptions about barriers and facilitators for participation and to gain a general evaluation of the PRBT intervention and care model in the context of its acceptance, feasibility and sustainability. In addition, FIN group participants were asked about their falls, sleep and general mental health in the context of the effect of the intervention.

Data collection

Qualitative data collection occurred during the intervention (DNS, DNF) and post-intervention (FIN, exercise physiologists, transport drivers). In the case of DNS, DNF and FIN participants, telephone interviews were conducted. For the exercise physiologists and transport drivers, focus group interviews were undertaken on location at Burnie Brae; and for the exercise physiologists a small diary was completed 7 days before and 7 days after the focus group interview. All interview sessions were led by Dr Anthony Tuckett, an experienced qualitative researcher sensitive to the target population and followed a semi-structured script. Focus group sessions were digitally recorded and transcribed verbatim.

Qualitative phase

Sampling in qualitative research usually relies on small numbers with the aim of studying in depth and in detail. Seeking a richness of data about a particular phenomenon, the sample is derived purposefully rather than randomly. Purposeful sampling tends to be used in qualitative research. A sample size of 14 (DNS), 6 (DNF), 54 (FIN) were telephone interviewed; 5 exercise physiologist diaries were completed attendant to a single focus group interview comprising 4 exercise physiologists; and a single focus group interview comprising 3 transport drivers was undertaken. Interviews ranged in duration from a few minutes up to 45 minutes.

Typically the broad question(s) for the different participant interviews were as follows:

Participant	Question(s) for semi-structured (and AEP diary)
DNS, DNF	Tell me about your experience of the program so far? Why did you [not start, not finish]?
FIN	Talk to me about what attracted you to join the Muscling Up Against Disability program? How did you find out about it? Is there anything you would change about the program – what worked well? What did not work so well? Has there been any effect/change to your sleep/rest? Mood/mental health? Falls/balance? If you could speak to the Minister for Health, what would be your key message about this program? Did you receive the 'exit package'? Have you made any use of it?
Exercise physiologists	Tell me what you have observed... Can you give me examples of... (Improved strength, balance, social cohesion, mood)? What did the older people talk about whilst in the gym? Talk to me about those who dropped out? Reasons and interpretations of why? What worked well? What did not work well? Are there ways you think the program could be improved in terms of efficiencies (time- yours or older person; costs; equipment; gym environment)? What are your thoughts about the gym design? What about Club MUAD now being embedded in the 'main' gym? Do you have any thoughts about the length of the program? Talk to me about the equipment... How was the equipment experienced by the older persons? (Can you give me an example?) Is the HUR equipment (really) necessary; Talk to me about your role... Could the Muscling Up Against Disability program be 'run' by PTs (or someone taught how to run the machines and put the older person through the exercise)? What do you think about the exercise physiologist - older person ratio and how it all has worked?
Transport drivers	What worked well/did not work well with regards to the transport provided as part of the Muscling Up Against Disability program? Are there ways you think the program could improve in terms of the transport pick-up/drop-off efficiencies? In the case of a national roll-out of Muscling Up Against Disability program, what would be the best transport model? Tell me about changes in the clients at pick-up/drop-off over the exercise period (observed). Were you aware of what the participants talked about (heard) about the program?

Only data from the FIN group are presented here. Within these narratives, are representative cases that describe how participation has led to incredible positive change in the participant's life.

FINDINGS

Case Studies

Case Study 1

Margarite is a 79 year old very recent widow who has been “in a bad way” with bowel cancer (“they took out my bowel 7 years ago”). She has a colonoscopy bag. Hers is a story of inspiration, the healing ability of exercise and realising a promise. Margarite received “a letter from Burnie Brae somehow and after I assessed it (what the Muscling Up Against Disability program was about) I said: “Yes”.

Margarite told of how she “was in a bad way with bowel cancer and following a bowel resection 7 years ago”. The cancer and her ill health had forced her to give up bowls. Prior to the Muscling Up Against Disability program, Margarite had a minor operation which meant “I began to put on weight and improve my energy”. Margarite perceived the Muscling Up Against Disability program as a way “to get back to bowls, my goal is to get back to bowls”. For her, “at the end of the 6 months exercise, I could stand on one leg, this might not mean much to you, but for me, my balance, it was a great achievement”. Margarite was adamant that the program gave her “stronger (sic) with my muscles”.

Margarite was able to give example of how the resistance training had changed what she could do at home. She recounted; “Now I can bend over to dig weeds, cut bushes, trim them. I love doing that at 4am, so that when my daughter comes to do the garden, it’s not a big job. I can keep it to my height. I can do more cleaning, I can do that, in the house, and shopping. I can go shopping without my walker and I can do my shopping for longer than I could before. I nursed my husband when he died and I was unwell. Exercise gave this all to me”.

The transformative effect of exercise on Margarite means that she is willing to now forgo other items in her life in order to keep going twice a week to Club MUAD (the ongoing version of the Muscling Up Against Disability program); “This is why I am paying \$80/ month. I am getting out of pocket \$20/week so I cut down on other things. I’ve got to drop my newspaper. Oh I love my newspaper but, I really want to get back to bowls”.

Margarite was clear that the exercise had had no effect on her sleep/rest; “I’ve always been a dreadful sleeper”, though obviously the program significantly improved her balance. She was ambivalent about the effect on her mood/mental health; “Mood, yes, I guess so?”, though the effect on her physical wellbeing and resultant capacity to undertake the April 2017 trip by train to Longreach means she will experience happiness.

Margarite’s Key Message was as follows: “100% I’ll back it 100%. It’s been fantastic for me and my family see the difference”.

She was prompted to explain what she meant by “my family see the difference”. “I’ll tell you what my family are doing, I come from Longreach, I have always wanted to go back to Longreach, my late husband did not, he’s from Gympie, a radiologist actually, before he died he asked my daughter (Mary, she’s 56) to take me back. My daughter came to me in January and said “Mum, we’re going to Longreach”. (Margarite begins to cry). We are going on the “Spirit of the Outback”. I am going First Class. I will worry about the expense when I get back in April. I am really looking forward to my trip”.

FINDINGS

Case Study 2

Malcolm [aged 67] spoke with his wife (his carer) Maeve also on the telephone line. Malcolm attended the Muscling Up Against Disability program with his mother-in-law [aged 83] (Maeve's mother). This interview also reveals how the Muscling Up Against Disability program had an effect on Maeve as a carer.

Malcolm is a Burnie Brae member and saw a "flyer" for the Muscling Up Against Disability program whilst at Burnie Brae's Project Pantry and he also recalled getting "contacted by letter by Burnie Brae".

In Malcolm's words, the program "was pretty good, did us a lot of good". When pressed to explain, Malcolm stated he had improved mobility, strength and his repetitions had increased. Further, Malcolm stated his "mobility and strength" meant he could better do "handyman things such as mowing and doing the edges". Without prompting, Malcolm acknowledged the regime meant he was "sleeping better and had better physical health".

Maeve interjected. She explained how the exercise had given Malcolm "a lot more movement after his knee operation" and how Malcolm when he had "limited movement was frustrated but with the increased movement he wasn't frustrated".

Malcolm added that the exercises meant he "could climb the stairs". Later in the interview, when Maeve spoke about Malcolm "complain[ing] about going up stairs and he'd say I'll need a stair lift" they both agreed with each other that the exercise has meant not having to get a chair lift (stairs).

Malcolm complimented the staff involved; "everyone's pleasant", as well as the program: "all those machines, it was properly managed".

Whilst Malcolm was waiting to hear back from Burnie Brae at the time of this interview, he did think the cost for Club MUAD (\$20/week) "was another thing to budget" and when combined with his mother-in-law, "expensive as I and Maeve are struggling to pay private health insurance as well".

Malcolm's key message (set against the context of cost burden) was as follows: "The benefits outweigh the cost. It keeps people out of rehab'. We looked forward to going. We don't have the equipment at home, so can't do those exercises. It is worthwhile health-wise and saves the Government money in the long run".

Maeve interjected to speak about her observations of the Muscling Up Against Disability program on her, her mother and her husband. She agreed and the timbre in her voice emphasised the effect of the program on her husband and mother meant it had a positive effect on her. She was less burdened, for example, at Christmas time, because "they (the pair of them) could do things!" She was upbeat when she described her husband as less "frustrated" because of his increased movement. She stated; "I thought it was wonderful (as carer) takes load off my mind as well to see my mother walking".

When describing the change on her mother, Maeve described how her mother "shuffled along" but with the exercise and going to the gym "she changed her clothes to be more suitable, she lifted her feet, she loved the girls there. I noticed a difference in her mind, she looked forward to going there twice a week, to get out of the house. I noticed a difference".

Maeve felt that her mother would struggle to pay the weekly gym fee given her (mother's) single pension.

FINDINGS

Case Study 3

Madalyn turned 91 years old in June 2017. She spoke with a strong, vigorous voice, full of force and great humour and about the Australian Open (“Raffa and Federer”). A real delight, willing to forgo breakfast to take the telephone call (“it’s only a bowl of Special K”) before “heading off to Burnie Brae for Club MUAD [the ongoing exercise program that arose after the research study ended]”.

Madalyn has a long affiliation with Burnie Brae and like others, received a letter of invitation to join the program. She stated; “my family said “Go for It””, and so she did. Her global summary of the Muscling Up Against Disability program was she “liked it” and obviously enough to “continue on with it”. When prompted, her understanding of this “like” was explained as follows; “I liked the company of the two girls who run it, and (Research Manager) was wonderful, so I liked the social part of it and I did enjoy doing it (the exercise)”.

Madalyn thought (initially) she “did improve”. However, when prompted, she clarified; “Honestly, I haven’t noticed anything, but the feedback (the report from the program) said so, I just feel well”. Madalyn explained that “balance is good” and acknowledged “that’s the part that has improved” and she correlated this with her explaining that her daughter (Macy, 61 years old) was an exercise physiologist who “had read the report”. Of importance, she added that because she “liked it” this is why “I’ve continued on with it”.

Madalyn could not link any changes to sleep/rest (“I’ve always been a good sleeper, I can sleep anywhere”) nor her mood/mental health (“My memory is not 100% I do repeat myself, my daughter says: “Mum you’ve already told us that”).

About the HUR equipment and the costs to continue in the program (Club MUAD), Madalyn made the following claims. On the equipment; “it’s hard, a couple of machines make you work very hard”. About the cost, this was not an issue (obviously given she was back at Club MUAD). Her key message to the Minister for Health was: “It’s a wonderful project”. Madalyn had “read bits and pieces” of the exit package and “will never throw it away”.



Control group participants attended monthly education seminars.

RESEARCH BUDGET - MUSCLING UP AGAINST DISABILITY

Item	Amount
Consultancy	
Professional consultancies	\$163,347
Personnel	
Administration staff	\$34,016
Research assistant	\$140,121
Research manager	\$265,207
Exercise physiologists	\$420,363
Equipment	
HUR equipment hire	\$115,587
Hart sport	\$629
Laptop and software	\$3,750
Assessment tools	\$24,360
Other	
Fuel (transport)	\$229,722
Administration consumables	\$2,925
Steering committee and administration	\$22,075
Total	\$1,422,102

This program was supported by a Commonwealth of Australia Department of Social Services Aged Care Service Improvement and Healthy Ageing Grant [Grant ID: 4-Z35FF5, awarded March 2015] and the Australian National Health and Medical Research Council - Australian Research Council [Dementia Research Development Fellowship to Paul Gardiner #1103311].

Contribution in kind	Amount
Transport driver wages	\$211,680
Total	\$211,680

COSTS OF INTERVENTION DELIVERY

A manuscript exploring the cost-utility and cost-effectiveness of the Muscling Up Against Disability program is being prepared for publication. The costs detailed below were used in analyses for this manuscript along with health service utilisation costs. Changes in participants' EQ-5D-3L scores were used to assess the utility of the intervention.

Intervention costs

Participants across the 4 intake waves of the exercise intervention equated to > 1470 hours of PRBT across two sites. Sessions catered for a low number of participants initially, then peaked at 32 hours per week during the last 6 months of 2016, before tapering down to the end of the intervention period (see Figure 1). The cost of an accredited exercise physiologist to provide these hours was averaged at \$41.10 per hour (inclusive of wages, on-costs and overheads). Direct cost to the project for the provision of exercise physiologists to deliver the intervention across the life of the project was \$63 500.

In addition to the direct cost of intervention provision, two exercise physiologists within the study spent an equal amount of time in project management and delivery tasks, such as training, collecting assessment data and maintaining data consistency. The primary exercise physiologist to the study was employed for the duration of the project in a full-time capacity. In addition to their exercise delivery role they served as research assistant to the research manager, to support the day to day running of the project.

Due to being a capital outlay, equipment costs are not included as a delivery cost. Similarly, project delivery costs associated with conducting the research such as administration, consultancy, promotion, assessment testing, participant communications, data collection, data analysis and reporting are not considered as intervention costs. To this end the cost of intervention delivery is reflective of what other providers would incur for providing the Muscling Up Against Disability program to up 245 participants over a 2-year period.

Control group activities

Cost of providing education seminars for the control group was calculated at \$2 658. Costs include presenter remuneration, hall hire and catering but exclude transport costs.

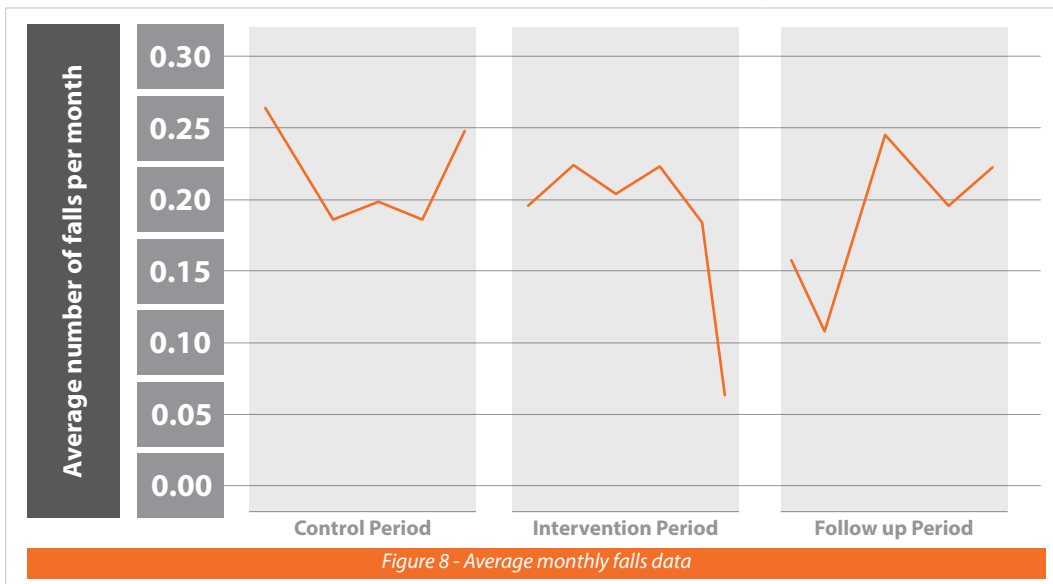
Transport costs

During the program 120 participants relied on transport provided by Burnie Brae to attend exercise sessions. The average trip length to or from exercise, calculated using Google maps, was 10 km per session attended. Based on wages, administration costs, fuel and vehicle overheads such as depreciation, insurance and maintenance for the Burnie Brae fleet of half paid and half volunteer drivers, the transport costs of a single session attended was calculated to be \$40. Return transport for 24-weeks of twice-weekly exercise for those reliant on transport was in excess of \$230,000. This was exclusive of session attendance external to exercise participation such as assessments and control group seminars. For exercise participation, if all participants had used Burnie Brae-provided transport, as originally budgeted for, transport support for the project would have been \$470,400 before the support of extra services.

BENEFITS OF INTERVENTION

Falls

Daily falls data taken from participant diary records were averaged monthly across the control, exercise and follow up periods. These averages are presented in Figure 8. The change in mean monthly fall rates between months 1 and 6 of the control, intervention and follow up periods were -6.5%, -65.8% and +44.1% respectively.



Health service utilisation

Health service costs were derived from two sources, the Independent Hospital Pricing Authority report 2016 [34] (for emergency department and hospitalisation costs) and the Australian Medical Association list of service fees 2016 [35] (for general practitioner and specialist fees).

Multiplying these costings by average service usage data from the daily diaries of participants showed that wait list control group members experienced a reduction in service access costs from \$868 in month 1 to \$640 in month 6, a reduction in mean health service access costs over the 6 months of \$220. Across the exercise intervention phase participants experienced a steady reduction in mean service access costs from \$981 in month 1 to \$560 in month 6, an average reduction over 6 months of \$421 (see Figure 9).



CLUB MUAD

At the conclusion of the research study many participants expressed interest in continuing to do PRBT within the same environment at the Healthy Connections Exercise Clinic. As a result the clinic developed an ongoing program for graduates called Club MUAD. On exit from the Muscling Up Against Disability program, participants were provided with an 'exit pack' containing a summary of their progress through the program, a booklet containing tips for maintaining a healthy lifestyle and an invitation to join Club MUAD.

A fee structure was designed to make access to ongoing PRBT affordable to older people and sustainable for the clinic. Participants contribute \$10 per session to the cost of the program with the remainder of program delivery cost subsidised through the government's My Aged Care system. Case study 1 from the qualitative analysis suggests that participants see the value in maintaining regular PRBT exercise and some are prepared to make sacrifices in other expenditures to attend. Case study 2 highlights that even this subsidised amount can be a stretch for some older people.


Initially two sessions a week of Club MUAD were offered but these were quickly filled. More sessions were added and at present eight Club MUAD sessions are conducted each week catering for up to 8 participants per session.

Analysis of the follow up data arising from the Muscling Up Against Disability program for future publications is ongoing. Initial findings are that those participants who transitioned into Club MUAD have continued to improve their physical performance as measured by the SPPB. Their balance confidence has also been maintained in contrast to those who did not continue with regular PRBT whose balance confidence has declined significantly.

NEW

Club MUAD

A mixed group class to improve strength and balance




- Machine-based strength training using HUR equipment
- Challenging balance and functional fitness activities
- Led by Accredited Exercise Physiologists

Mondays 2pm & Wednesdays 3pm
Price: \$10 per session

Wed 2pm class now full! New times opening now.

Please call us on 3624 2185 for more information



healthyconnections
specialised exercise and health management

Club MUAD was developed to allow graduates to continue with regular PRBT exercise

PUBLICATIONS

Journal papers

Published

Keogh JW, Henwood T, Gardiner P, Tuckett A, Hodgkinson B, Rouse K. Examining evidence based resistance plus balance training in community-dwelling older adults with complex health care needs: Trial protocol for the Muscling Up Against Disability project. *Archives of Gerontology and Geriatrics* 2017; 68:97-105.

Under review

Hetherington S, Henwood T, Swinton P, Keogh JW, Tuckett A, Gardiner P, Rouse K. Predicting balance confidence among older adults with complex health care needs: Learning from the Muscling Up Against Disability intervention study. (Manuscript submitted to the *Archives of Physical Medicine and Rehabilitation*) 2017.

Summary

This study shows that poor balance confidence is related to low physical performance and increased frailty. However, employing a targeted intervention designed and supervised by accredited exercise physiologists, these variables can be positively modified and balance confidence increased.

Physical performance gains made through progressive resistance plus balance training contribute to improved balance confidence and those with the lower initial balance confidence realised greater improvements. Quality of life was also improved post intervention and this was also positively associated with improved balance confidence. However, the results also show that additional supports and scaffolding are needed to engage older adults with poor initial balance and low balance confidence. In an appropriate environment, with competent supervision and support, even frail older people can exercise to improve their strength, balance and quality of life and, as a consequence, their balance confidence.

In preparation

Keogh JW, Henwood T, Gardiner P, Tuckett A, Hetherington S, Rouse K, Swinton, P. How does the EWGSOP sarcopenia diagnosis criteria and the SARC-F compare at baseline and post progressive resistance and balance training in older adults initially accessing home and community aged care services? (Manuscript in preparation) 2017.

Summary

The results of this study suggest that there is consistency between the domains of the SARC-F questions and a substantial portion of the variance is explained by the perceived ability to climb stairs and rise from a chair. The results also indicated relatively poor agreement between SARC-F and the binary EWGSOP categorisation (especially with regards to sensitivity). Based on the multiple correspondence analysis results, this may be due to the fact that walking speed appears to be the only dimension that maps well to the SARC-F categorisation.

With regards to pre-post intervention, there appears to be consistency in change in the SARC-F domains. So again, those that demonstrate a positive change in one dimension are more likely to demonstrate a positive change in another dimension. However, there is no association between change in SARC-F domains and change in objective measures such as lean mass, grip strength or isometric leg strength. These results may suggest that the SARC-F is measuring something consistent that appears to respond to training, but what it measures is more complex than a simple variable such as muscle mass is the first outcome that influences the EWGSOP categorisation of sarcopenia.

PUBLICATIONS

Henwood T, Hetherington S, Keogh JW, Tuckett A, Gardiner P, Rouse K. Primary outcome measures from the Muscling Up Against Disability intervention study. (Manuscript in preparation) 2017.

Summary

For those receiving CHSP support, newly emerging disabilities limiting their capacity in activities of daily living. Progressive resistance plus balance training offers significant promise to the more commonly employed activities for these individuals, low intensity exercise, but remains underutilised. The aim of this study was to measure the physical benefits of 24 weeks of twice weekly progressive resistance plus balance training for older Australians receiving government funded aged care support. Delivery occurred in a larger senior citizens leisure's centre and included supported transport to and from training. Training was inclusive of moderate to high-intensity upper and lower-body resistance training and targeted balance exercise. Assessment included a range of muscle strength, muscle mass and functional assessment measures. Results support that participation in the Muscling Up Against Disability program led to superior gains in function and strength, particularly when compared to usual care. This has significantly impact for older adults looking to push-back against disability and for governments looking to prolong independence among their aged population.

Tuckett A, Hetherington S, Henwood T, Keogh JW, Gardiner P, Rouse K. The perfect fit: What community dwelling older people said about the Muscling Up Against Disability (MUAD) resistance plus balance training (RPBT) intervention. A qualitative evaluation. (Manuscript in preparation) 2017.

Summary

This paper reports on the qualitative evaluation of the project. It relies on the follow-up telephone interviews with the participants who did not start, did not finish and, in particular, those that completed the program. The aim is to offer health and aged care policy-makers and administrators insights into what makes an intervention of this kind work – how and why? This paper draws on the powerful stories from those community dwelling older people whose lives were changed for good.

Gardiner PA, Henwood T, Hetherington S, Keogh JW, Tuckett A, Hodgkinson B, Rouse K. Muscling up for brain health: Impact of a resistance training and balance program on cognitive function in older adults (Manuscript in preparation).

Summary

This study examined the impact of the Muscling Up Against Disability program on cognitive function. Both the intervention and control groups had high levels of cognitive function at the baseline assessment. The control group did not demonstrate any change in cognitive function during the period prior to receiving the intervention. However, those participants who received the intervention straight away improved their cognitive function by 0.58 units over the intervention period. A similar magnitude of change was observed in the control group from when they started training to final assessment.

PUBLICATIONS

Hetherington S, Swinton P, Henwood T, Keogh JW, Tuckett A, Gardiner P, Rouse K. Cost effectiveness of a progressive resistance plus balance training intervention for CHSP clients. (Manuscript in preparation) 2017.

Summary

This economic evaluation shows that a 24-week PRBT program has favourable cost-effectiveness and cost-utility ratios compared with standard care for older Australians receiving in-home care support. Cost savings were found with respect to visits to health care professionals, emergency department presentations and hospitalisations.

Industry publications

Henwood T. Exercise proves popular with residents. Australian Ageing Agenda. Nov/Dec Issue 2016.

Henwood T. Contemplating an evidence-based exercise model of care. LASA Q Focus. Autumn Edition. 2016.

Henwood T. Resistance training: A powerful tool to prevent later life disability. LASA Fusion. Summer Edition. 2015.

Summary

These industry publications leverage the positive outcomes of the Muscling Up Against Disability program alongside current evidence and recommendations to demonstrate how aged care providers can guide their customers into a better model of care, with health bringing outcomes.

Presentations

Symposia

Hobbins N, Boylan J, Henwood T. Fighting frailty one mouthful and one repetition at a time. IAHS/CURAVIVA Global Ageing Conference, 18-21 September, Montreux Music and Convention Center, Montreux, Switzerland. 2017.

Henwood T, Boylan J, Hall N, Bending M. Using evidence in practice: The benefits of aged care resistance based exercise. 9th World Congress on Active Ageing, 28 June-1 July, Melbourne Exhibition and Convention Centre, Melbourne, Australia. 2016.

Freiberger E, Landi F, Bautmans I, Henwood T. Sarcopenia and function in the oldest old. 9th World Congress on Active Ageing, 28 June-1 July, Melbourne Exhibition and Convention Centre, Melbourne, Australia. 2016.

Barnard R, Naso F, Henwood T, Patchett A, Vuorjoki-Andrsson E. World of Wellness – linking care, client and community in aged care settings to encourage successful active ageing. 9th World Congress on Active Ageing, 28 June-1 July, Melbourne Exhibition and Convention Centre, Melbourne, Australia. 2016.

PUBLICATIONS

Oral presentations

Henwood T, Boylan J. Making healthy normal. Modifying disability through exercise participation. Australian Aged Care Quality Agency Better Practice Conference, 10-11 November, Brisbane Hilton, Brisbane, Australia. 2017.

Henwood T. Muscling Up in aged care: Why providers should be implementing resistance training. Australian Aged Care Quality Agency Better Practice Conference, 10-11 November, Brisbane Hilton, Brisbane, Australia. 2017.

Posters

Henwood T. Fit for aged care, LASA National Congress 15-18 October 2017, Gold Coast Convention & Exhibition Centre, Gold Coast, Australia. 2017.

Summary

These presentations incorporate some level of outcome related to the Muscling Up Against Disability program. These were delivered at both international and national forums, to academic and sector audiences. These presentations establish for the audience that PRBT can be delivered safely and sustainably with significant benefits to those who participate.



Box stepping was one of the balance training activities.

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APPENDIX 1: DIFFERENCES BETWEEN COMPLETION GROUPS AT BASELINE

One-way ANOVA and LSD analysis of differences between completion groups at baseline

	DNS ¹ N = 30	DNF ² N = 47	FIN ³ N=168	F	p [†]	LSD [†]
Age (y)	80.4 ± 7.1	79.0 ± 6.5	78.3 ± 6.3	1.42	.25	
Gender (n (%)) female	23 (76.7%)	41 (87.2%)	131 (78%)			
Weight (kg)	77.9 ± 21.0	71.9 ± 20.0	76.7 ± 17.6	1.47	.23	
BMI	30.1 ± 7.5	28.4 ± 7.5	29.6 ± 7.5	0.91	.47	
Lean mass (%)	60.4 ± 9.6	62.2 ± 9.9	61.9 ± 9.8	0.36	.70	
SPPB	6.2 ± 2.5	7.0 ± 3.0	8.6 ± 2.5	15.64	.00	3>2,1
Walk speed (m/s)	.67 ± .20	.75 ± .31	.87 ± .24	10.77	.00	3>2,1
Chair stand (s)	35.0 ± 20.6	32.6 ± 20.5	22.4 ± 16.7	10.10	.00	3>2,1
Balance (s)	22.7 ± 5.6	25.6 ± 5.7	26.8 ± 5.0	7.92	.00	3,2>1
Isometric leg strength (kg)	53.6 ± 21.8	60.6 ± 30.3	66.9 ± 27.4	3.06	.04	3>1
Grip strength (kg)	18.4 ± 6.3	21.0 ± 7.2	22.9 ± 7.2	4.45	.00	3>1
SMM (kg)	20.9 ± 7.1	19.6 ± 5.8	21.3 ± 6.6	1.19	.31	
SMI (kg/m ²)	8.2 ± 2.4	7.7 ± 1.9	8.1 ± 2.1	0.87	.42	
Sarcopenia (n (%))						
EWGSOP definition	5 (16.7%)	7 (14.9%)	7 (4.2%)			
SARC -F	18 (60%)	21 (44.7%)	46 (27.4%)			
Frailty (n (%))	11 (36.7%)	22 (46.8%)	39 (23.2%)			
Morbidities (n)	4.6 ± 3.4	6.1 ± 2.8	4.8 ± 2.6	4.34	.01	2>1,3
Medications (n)	5.0 ± 3.8	5.7 ± 3.4	5.1 ± 3.4	0.62	.54	

Data are presented as mean ± standard deviation

† One-way ANOVA with least significant difference (LSD) calculations between DNS -those who did not start, DNF - did not finish and those who did finish (FIN)

y – years, n – number, % - percent, kg – kilograms, SPPB, Short Physical Performance Battery summary score, m/s- metres/second, s – seconds, SMM – Skeletal muscle mass, SMI – Skeletal muscle index, kg/m² – kilograms/metre², EWGSOP – European Working Group in Sarcopenia in Older People

APPENDIX 2: CONTROL GROUP EDUCATION SESSION DETAIL

Date	Title	Presenter
14th October 2015	Getting up and staying up: The importance of physical activity	Dr Justin Keogh
4th November 2015	Not all exercise is created the same: Understanding the difference	Dr Tim Henwood
2nd December 2015	Stand up to ageing: Prolonged sitting and health	Dr Paul Gardiner
23rd March 2016	Physical activity and exercise for wellbeing	Dr Tim Henwood Dr Justin Keogh
20th April 2016	LifeTec Australia presentation: Assistive devices	Mr Scott Green
17th May 2016	Staying motivated to stay healthy	Ms Lisa Curry
22nd June 2016	Getting up and staying up: The importance of physical activity	Dr Justin Keogh
20th July 2016	Not all exercise is created the same: Understanding the difference	Dr Tim Henwood
7th September 2016	Stand up to ageing: Prolonged sitting and health	Dr Paul Gardiner
5th October 2016	Nutrition workshops Brisbane presentation: Nutrition in later life	Ms Leanne Kuroda

