The Effect of Brief Interventions to Increase Physical Activity When Delivered in the Healthcare Setting.

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Abstract

Physical inactivity is a well identified contributor to morbidity and reduced life expectancy worldwide, yet physical activity (PA) participation in adults remains sub-optimal. Older adults and those with chronic health conditions face additional barriers to engaging in adequate amounts of PA. The healthcare setting provides an ideal opportunity to deliver interventions to promote participation in PA, particularly to older adults and those with chronic disease, however research to date has focused predominately on interventions delivered in primary care and little is known about their effect in other healthcare settings. The aim of this thesis was to optimise the PA levels of clients being discharged from community rehabilitation. This involved a systematic review and a randomised controlled trial to test the feasibility of a brief intervention to increase PA in the community rehabilitation setting.

A systematic review (n=25 included papers) demonstrated that some brief interventions to increase PA, delivered in a healthcare setting other than primary care, are effective at increasing PA in the medium-term. However, further research is required to determine the long-term impact of such interventions, and the wide variation in definition and types of 'brief interventions' makes it difficult to determine which features optimise outcomes. In a feasibility randomised controlled trial (n=40 participants), it was feasible to deliver education and counseling to support the long-term adoption of regular PA to clients attending community rehabilitation.

Collectively, the research presented in this thesis highlights the effect of brief interventions to increase PA, when delivered in the healthcare setting other than primary care and may facilitate the implementation of these type of interventions in a

greater variety of healthcare settings. In the community rehabilitation setting, while it is feasible to deliver brief interventions to increase PA, refinement of the study protocol is required prior to further research to assess the clinical benefits of such an intervention.

Statement of Authorship

"This thesis includes work by the author that has been published or accepted for publication as described in the text. Except where reference is made in the text of the thesis, this thesis contains no other material published elsewhere or extracted in whole or in part from a thesis accepted for the award of any other degree or diploma. No other person's work has been used without due acknowledgment in the main text of the thesis. This thesis has not been submitted for the award of any degree or diploma in any other tertiary institution."

Emily Green

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Publications during enrolment

The thesis includes two original papers: one published and one submitted for publication, all of which included co-authors.

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My contribution to the work is described prior to each chapter they are presented in.

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List of Abbreviations

PA	physical activity
MET	metabolic equivalent of task
WHO	World Health Organization
SD	standard deviation
MD	mean difference
SMD	standardised mean difference
CI	confidence interval
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses

Chapter 1: Background

Physical activity (PA) is defined as “any bodily movement produced by skeletal muscles that requires energy expenditure” and includes all movement derived from structured activity, leisure-time, transportation, or work [1]. Physical inactivity is defined as “an absence or in-sufficient level of PA required to meet the current PA recommendations” [2]. Physical inactivity is well established as a key modifiable risk factor for leading non-communicable diseases, in particular heart disease, stroke, diabetes, and breast and colon cancer [2]. It is estimated that eliminating physical inactivity could increase life expectancy and reduce the incidence of coronary heart disease, type 2 diabetes, and breast and colon cancers by up to 10% [3]. Further, PA contributes to the reduction of other non-communicable disease risk factors, such as hypertension, overweight and obesity [2]. Low cardiorespiratory fitness has been identified as the single leading risk factor for all causes of death [4] and PA is estimated to account for 9% of all premature mortality [3]. Beyond the burden of physical disease, PA has been demonstrated to improve mental health, delay the onset of dementia and improve quality of life and well-being [2]. Sedentary behaviour refers to “any waking behaviour characterized by an energy expenditure less than 1.5 metabolic equivalents (METs), while in a sitting, reclining or lying posture” [2]. Sedentary behaviour is associated with further adverse health outcomes, including all-cause mortality, cardiovascular disease mortality, cancer mortality and incidence of cardiovascular disease, cancer and type 2 diabetes [5].

1.1 Physical activity guidelines and participation

Global PA and sedentary behaviour guidelines recommend all adults and older adults aim to accumulate a minimum of 150 minutes of moderate intensity, or 75 minutes of vigorous intensity, PA per week, with participation in additional PA offering greater health outcomes [1]. The guidelines outline the importance of completing muscle strengthening exercises at least twice per week and recommend older adults (65 years and above) also incorporate balance and flexibility exercises into their routine. It is recommended that all adults limit time spent being sedentary, and that replacing this time with PA of any intensity offers health benefits. Further, that to reduce the detrimental effects of sedentary behaviour, adults should aim to participate in more than the minimum recommended amount of moderate to vigorous intensity PA [5].

Globally it has been estimated that 23% of adults do not meet PA guidelines, with rates of inactivity up to 70% in developed nations due to transportation use, use of technology and urbanization [2]. In Australia, more than half of adults do not meet PA guidelines [6]. Within countries, a number of subgroups experience significant inequities in opportunities for and participation in PA, these include; women, older adults, those with low socioeconomic status, those with disabilities and chronic illness, marginalized populations, indigenous peoples and those who live rurally [2]. This thesis will focus on the PA levels of older adults and in particular, older adults with chronic illness. In Australia, up to three-quarters of older adults, aged 75 and over, are not sufficiently active [6]. Barriers to PA for older adults have been identified as lack of time, knowledge, self-discipline or motivation, ill health or changing health status, potential for injury, access, cost and lack of self-efficacy [7].

For those with chronic disease, rates of PA vary. Only 30% of those with osteoarthritis meet PA guidelines [8]; stroke survivors are 39% less likely to meet PA guidelines than age matched healthy adults [9]; individuals with congestive heart failure are 32% less likely; and those with spinal cord injury are 66% less likely [9]. Besides the health risks associated with low levels of PA for someone with a chronic condition, in many instances an inactive lifestyle compounds the effect of the condition, potentially restricting functional ability and personal independence [9]. A study investigating post arthroplasty PA levels in participants with osteoarthritis found that pre-operatively participants spent 82% of their day in sedentary activities [10]. Six months post-operatively, despite patient-reported improvements in pain, function and physical ability, objectively (device) measured PA was unchanged, with 83% of participant time spent in sedentary activity and only one of 52 participants meeting PA guidelines [10]. This highlights the challenges and complexity of behaviour change in older adults and those with chronic conditions.

In 2013, the financial burden of physical inactivity to the healthcare system was conservatively estimated to be $54 billion/year globally [11]. A further $14 billion/year globally is attributed to loss of productivity as a result of physical inactivity related deaths [11]. In Australia, the combined costs of healthcare expenditure and loss of productivity were estimated to be $805 million per year [11]. Increasing PA levels is an important investment, which could lead to considerable savings in healthcare spending. Health promotion and disease prevention programs can empower individuals to make healthier choices and reduce their risk of disease and disability [12]. Further, many preventative health interventions are cost effective, reducing the need to treat expensive diseases and improving quality of life, at a reasonable cost [13]. A 2017 report

estimated that only 1.3% of all health care spending in Australia is on preventative health, substantially less than Canada, the USA, the UK and New Zealand [13]. While health promotion interventions targeting physical activity have been demonstrated to be cost effective [14], in 2007-8 less than 2% of Australian general practitioner consultations provided exercise counseling advice [15]. This figure sits in stark contrast to the known rates of physical inactivity, particularly in older adults and those with chronic disease, who are most likely to be accessing general practice services in primary care. Addressing physical inactivity is an important public health priority. Preventative health promotion in this space has the potential to reduce burden of disease, extend lives and reduce healthcare spending worldwide.

1.2 Interventions to promote physical activity participation

If physical inactivity could be reduced by 25%, it is estimated that more than 1.3 million deaths/year could be avoided worldwide [3]. Meanwhile eliminating physical inactivity completely could avert up to 5 million deaths/year globally [1]. Global and national guidelines call for the implementation of strategies to urgently address physical inactivity. The World Health Organisation's (WHO) '*Global Action Plan on Physical Activity 2018-2030*' calls for a 15% relative reduction in the global prevalence of physical inactivity in adults and adolescents [2]. To achieve this goal, it outlines policy actions calling for public health messaging supporting the uptake of PA for all ages, creation of environments that promote PA, programs and opportunities to support engagement in PA for all age groups and abilities, and investment in systems to enable change on national and international levels [2].

Large scale systematic reviews [5, 16-18] have investigated the effect of population level interventions to increase PA. In the United States, a Task Force on Community Preventative Services led a large scale review on the effectiveness of interventions to increase PA [16]. The resulting evidence was graded according to *The Guide to Community Preventative Services* [19] as 'recommended against', 'insufficient', 'sufficient' or 'strong'. Figure 1 represents the findings of this review. Strong evidence exists for a number of behavioural and social approaches to increase PA, including social support interventions in community settings and individually adapted health behaviour change programs. Social support interventions focus on changing PA behaviour through "building, strengthening and maintaining social networks", to provide supportive relationships for behaviour change. These interventions were associated with a 44% median change in time spent in PA for adults and older adults. 'Individually adapted health behaviour change programs' [16] are tailored to the individual's readiness for change, specific interests and preferences, these programs resulted in a median net increase of time spent in PA of 35% in adult and older adult populations. They incorporate goal setting, building social support for new behavioural patterns, behavioural reinforcement strategies and problem solving to overcome barriers and prevent relapse.

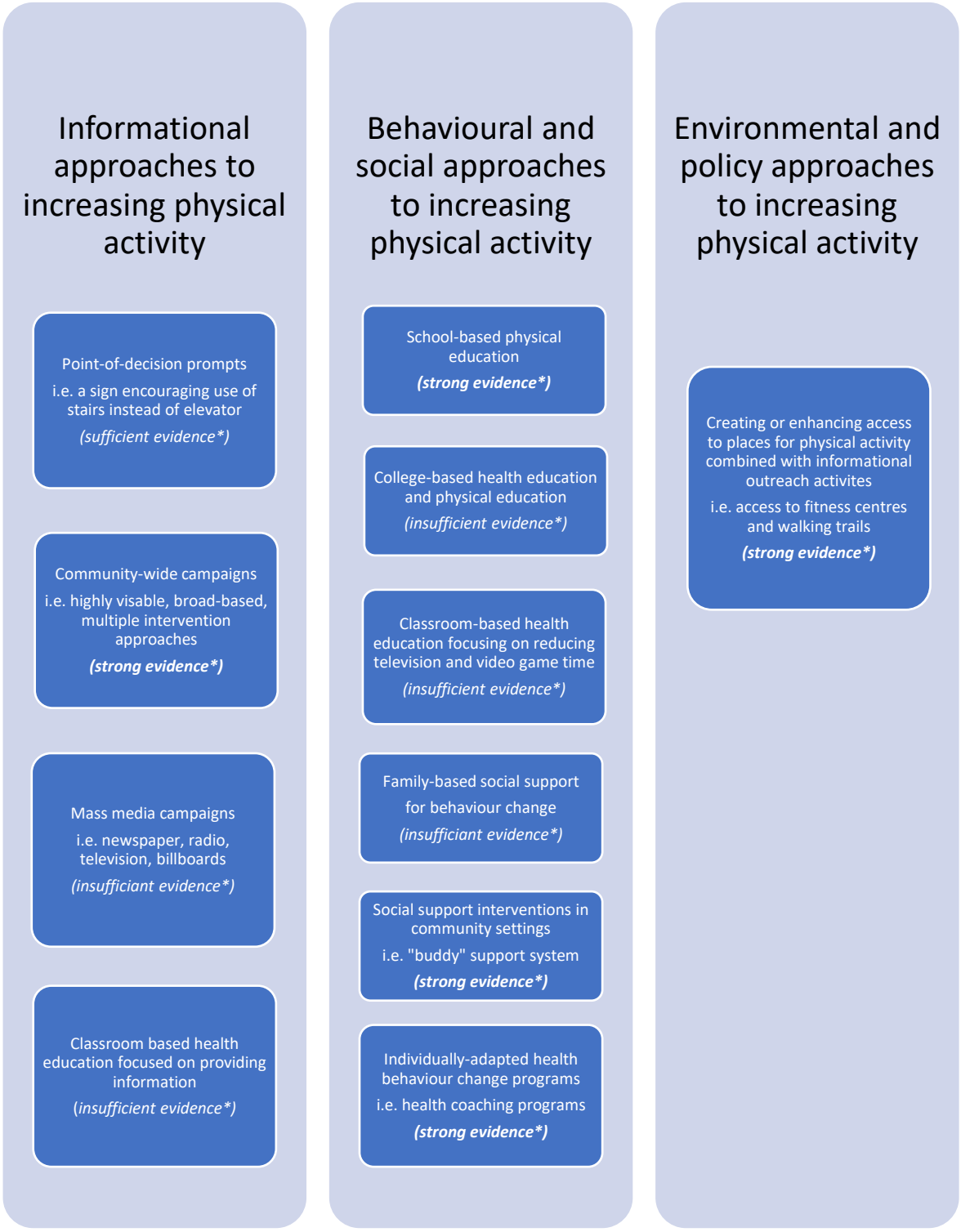

Figure 1.1 The effectiveness of interventions to increase physical activity for all age groups

* level of evidence as per The Guide to Community Preventative Services[19]

A large meta-analysis examining the effect of interventions to increase PA among healthy adults, including 99,011 participants, found PA interventions to be modestly effective (effect size (ES) 0.19) [20]. Interventions included in this review ranged from a single motivational educational session (median duration 60 minutes) to extensive supervised exercise sessions occurring over many weeks (median 45 minutes duration, 27 sessions). This analysis found that interventions aimed at an individual level were more effective than interventions aimed at a whole community (ES 0.19 and 0.09, respectively) [20]. Interventions employing behavioural strategies, such as goal setting, self-monitoring and use of cues, were more effective (ES 0.25) than those without (ES 0.17) [20]. There is no single intervention or approach to increase PA that will reach all demographics. A number of guidelines and reviews have examined effective delivery modalities and challenges in specific population subgroups, including older adults and those with chronic illness.

Older adults

"Increasing levels of PA is one of the most important steps older adults can take to improve and maintain their physical, social and mental health, and quality of life" [21]. For the purpose of this thesis, the term 'older adults' refers to adults aged 65 years and over, unless otherwise specified. PA plays a key role in preventing, or delaying the onset of, and in managing a range of chronic diseases [22]. This is particularly important for older adults, given 80% of Australian older adults are estimated to suffer from one or more chronic conditions, with 55% estimated to suffer from two or more [23].

Furthermore, remaining physically active assists in maintaining functional independence, preventing falls, and negating the effects of sedentary behaviour [5].

Like most high-income countries, Australia has a large and growing older adult population, with the portion of older adults forecast to increase from 15% to nearly 23% by 2050 [24]. This growth, combined with the substantial burden of chronic disease older adults carry, raises significant concern about both the cost and ability of the healthcare system to meet future demand. It has therefore never been more important to focus resources on preventative health, in particular, promoting PA and addressing barriers to activity participation for older adults. Guideline recommendations to support older adults to be more physically active include: modification of environments to increase opportunities for PA; implementation of social and community interventions to support older adults to live more active lives; and delivery of education about the health benefits of PA and of breaking up periods of prolonged sitting [21].

A number of systematic reviews have investigated the effect of interventions to increase physical activity in older adults. These reviews are summarised in Table 1.1. A large systematic review examining the effect of a range of supervised exercise and behavioural interventions to increase PA in older adults, found these to increase PA behaviours of community-dwelling older adults (ES 0.18, $p<0.001$), with a mean difference of 620 more steps/day or 73 more minutes of PA/week for the intervention group compared to the no-intervention control group, in the short-term [25]. Interventions included in this review comprised 15 sessions (median), with each session lasting 60 minutes (median). Interventions were delivered over 90 days (median).

Certain intervention delivery characteristics impacted their effectiveness specifically, interventions with a theoretical basis were more effective than those without; and interventions employing a combination of cognitive and behavioural strategies were more effective than those using one of these strategies alone. Further, the use of motivational-interviewing, problem solving techniques, strategies to manage barriers, and inclusion of audio-visual and/or mailed materials also enhanced effectiveness [25]. Another review, studying the effect of health coaching interventions on PA levels of adults aged 60 and over, found these to have a small but significant effect on PA levels (27 studies; standard mean difference=0.27; 95% confidence interval 0.18 to 0.37; $p<0.001$) [26]. In this review, interventions primarily delivered face-to-face were found to be more effective than those delivered by telephone. These reviews support the application of interventions to increase PA in older adult populations and give insight into intervention delivery characteristics which may enhance effectiveness.

Table 1.1 Summary of systematic reviews on interventions to increase physical activity in older adults, those with chronic disease and in the primary care setting.

Publication	Inclusion criteria	Participants	Intervention details	Results	Conclusions
Older adults					
Chase JA. 2014 Interventions to Increase Physical Activity Among Older Adults: A Meta-Analysis. [25]	Published: 1960-2013 Intervention: PA interventions Population: • Community dwelling older adults • Age 65 and older, or with a sample mean age of 70 • Contained at least 5 participants Reported enough data to calculate ES English	Median age 75.35 Median study sample size n=39 Women 70% Minority 15% Mean BMI 27.7(kg/m2)	• Intervention median 15 sessions • Session duration median 60min • Medan total duration of intervention =970min • Median days over which treatment occurred =91.5	• 33 single group + 46 two group treatment v control studies • ES calculated from 13,829 subjects • Mean ES for two group comparison= 0.18 (p<.001) • Equivalent to 620steps/ day or 73 minutes of PA/week • Factors positively influencing effectiveness: • Use of audio-visual material (0.48) • Mailed material (0.34) • Theory-based (0.28) • Combined cognitive and behavioural strategies (0.23) • Motivational-type interventions (0.20)	PA interventions significantly improved PA behaviour among community-dwelling older adults. Effective PA Interventions may be efficiently delivered using already available resources and personnel.

Publication	Inclusion criteria	Participants	Intervention details	Results	Conclusions
Oliveira JS, Sherrington C, Amorim AB, Dario AB, Tiedemann A. 2016 What is the effect of health coaching on physical activity participation in people aged 60 years and over? A systematic review of randomised controlled trials. [26]	Participants: 60 years or over, or median age of at least 60 years Recruited: from any setting Interventions: involving health coaching aimed at increasing PA participation	Mean age ranged from 60-79 years Healthy older adults & trials specifically in older adults with chronic disease Recruited from: • 8 primary care • 6 community • 5 hospital • 3 outpatient clinic • 2 pulmonary rehab • 1 senior centre • 1 rural community • 1 cancer registry	Interventions included individually tailored discussion from a health coach, via; • Telephone • Mobile technology • Internet • Face-to-face coaching OR • Motivational interviewing	27 trials included 5803 participants included in the primary analysis Effect of health coaching on PA levels vs control (SMD=0.27; 95%CI 0.18-0.37; p<0.001, I^2=61%) Factors positively influencing effectiveness: Face-to-face delivery SMD=0.41, p<0.001 No significant difference between trials recruiting people with a health condition & those recruiting healthy older adults (p=0.32). Health condition; 14 trials, SMD 0.32, p<0.001 General healthy older adults, 13 trials, SMD 0.23, p<0.001.	Health coaching is an effective intervention for increasing PA participation among people aged 60 years and older. There findings are generalisable to both healthy older adults and older adults with clinical conditions.

Publication	Inclusion criteria	Participants	Intervention details	Results	Conclusions
Adults with chronic disease					
Conn VS, Hafdahl AR, Brown SA, Brown LM. 2008 Meta-analysis of patient education interventions to increase physical activity among chronically ill adults. [22]	Participants: chronically ill adults >18 years Intervention: explicit intervention to increase PA Outcome: PA as an outcome Reported enough data to calculate ES English	Mean age median 59 years Mean sample size n=62 Proportion female 49% Range of chronic illnesses included in studies: • Cardiac • Diabetes • Arthritis • Cancer • Respiratory disease • Neurological conditions • Musculoskeletal • Mixed	Most common intervention was supervised exercise: Minutes supervised ex per session median 60min Total no of supervised ex sessions 36 median No of weeks interventions was delivered 12 median Mediated motivational or educational interventions (telephone, mail, internet) Mediated interventions	22,557 subjects 163 reports Mean effect in two group studies ES=0.45 ES equates to a difference of 48minutes/week or 945 steps/day for intervention. Factors positively influencing effectiveness: • Targeting only PA behaviour (0.57) • Use of behavioural strategies (0.53) • Arthritic participants (0.61) • Diabetic participants (0.49) • Cardiac (0.40) Factors that did not impact ES: • Supervised exercise • Individually tailored • Individual vs group	Moderate PA behaviour effects following diverse patient educational interventions. Behavioural strategies such as goal setting, self-monitoring, more effective than cognitive strategies such as decisional balance, management of barriers to PA. Greater response to intervention in some chronic disease groups over others.

Publication	Inclusion criteria	Participants	Intervention details	Results	Conclusions
				• Mediated delivery (telephone, mail) • Cognitive strategies	
Primary care delivered interventions					
Orrow G, Kinmonth A-L, Sanderson S, Sutton S. 2012 Effectiveness of physical activity promotion based in primary care: systematic review and meta-analysis of randomised controlled trials. [34]	Participants: adults (>16 years), determined to be sedentary, attending primary care Intervention: any physical activity promotion intervention, primary goal to increase PA Outcome: PA or fitness Design: RCT Follow up: min 12 months	Age range: 17-92 years 54% female Recruited in primary care In 4 trials, participants were selected for adverse vascular risk or cardiovascular disease. Remaining trials recruited from the general primary care population.	• Most interventions took place in primary care • Included health professionals in delivery • Involved advice or counselling given face-to-face or by phone (or both) • Multiple occasions of intervention	16 papers (15 RCT's) included 8,745 participants 11 studies reported positive intervention effect on self-reported PA at 12 months; these were significant in 6 studies. Pooled analysis of 13 studies; Dichotomous data, small to medium effect, odds ratio 1.42, 95%CI 1.17 to 1.73, I^2=43% Continuous data, SMD 0.25, 95% CI 0.11 to 0.38, I^2=70% Number needed to treat to move one sedentary adult to meeting guidelines at 12 months =12 (7 to 33)	Promotion of PA to sedentary adults recruited in primary care increases PA levels at 12 months, as measured by self-report. Insufficient evidence to recommend exercise referral schemes over advice or counselling interventions.

Publication	Inclusion criteria	Participants	Intervention details	Results	Conclusions
Lamming L, Pears S, Mason D, Morton K, Bijker M, Sutton S, et al 2017 What do we know about brief interventions for physical activity that could be delivered in primary care consultations? [35]	Review of reviews Participants: adults of any health status, except those undergoing rehabilitation or being treated in secondary or tertiary care, with serious conditions requiring specialist support & athletes. Setting: primary care Intervention: promoting lifestyle PA, delivered one to one with a face-to-face component Outcomes: PA or sedentary behaviour	Limited detail available	3 reviews focused on brief interventions. 13 focused on PA interventions in general.	Brief interventions can increase self-reported PA in the short-term, there is insufficient evidence regarding their long-term impact. Mixed evidence that providing written prescriptions or including follow up sessions may increase the effectiveness. Insufficient evidence to identify the effect of tailoring of intervention materials, types of providers, provider training, setting or theoretical basis, on brief intervention effectiveness	Brief interventions can increase self-reported PA in the short-term, there is insufficient evidence regarding their long-term impact & impact on objectively measured PA. Current definitions include brief interventions that are too long for primary care consults. Future research should focus on very brief interventions (<5min)

BMI= Body Mass Index, CI= confidence interval, ES= effect size, PA= Physical Activity, RCT= randomised controlled trial, SMD= standard mean difference.

Use of health behaviour change models in the development of interventions aimed at increasing PA has become increasingly prevalent [17]. Theory-based behavioural interventions have been demonstrated to increase PA 10-15% more than usual care [18]. Initially developed for use in smoking cessation, the transtheoretical model describes the process of health behaviour change and breaks this process into six stages-of-change; precontemplation, contemplation, preparation, action, maintenance and relapse [27]. The transtheoretical model of behaviour change has since been used to tailor interventions to increase PA [28], demonstrating both short- and longer-term improvements in PA in adults [27] and older adults [29, 30]. The model has been validated for use in community-dwelling older adults [29].

Chronic disease

Whether interventions to increase PA are equally effective in populations with chronic illness as they are in healthy older adult populations remains unclear. In one systematic review, PA behaviour change interventions tested among healthy older adults were demonstrated to be more effective at increasing PA than those tested on chronically ill older adults [25]. Another review suggested there was no significant difference in the effect of health coaching between trials recruiting from healthy people and those with chronic disease [26]. However, a large meta-analysis of patient education interventions to increase PA among adults with a chronic illness, found these to be moderately effective (ES 0.45) at increasing PA levels [22]. When compared to findings from reviews in healthy adults (ES 0.19) [17] and older adults (ES 0.18) [25] it has been suggested that the presence of chronic illness may cause individuals to in fact be more responsive to PA

interventions [20]. Supervised exercise was the most common intervention included in the review (88 studies) [20], typically including two 60 minute session per week for 12 weeks. The next most common intervention was 'mediated motivational or educational intervention delivery' by telephone, mail or internet (54 studies) [20]. At follow up, intervention group participants were more active than participants in the no-intervention control group by a mean of 48 minutes/week or 945 steps/day [20]. The described literature suggests that interventions to increase PA may be as effective, or potentially more effective, in populations with chronic disease compared to healthy older adults.

Among studies investigating the effects of patient education interventions to increase PA in adults with chronic illness, significant ES heterogeneity was reported, with ES varying between major categories of chronic illness [22]. Participants with arthritis demonstrated the largest ES (ES 0.61) representing greater improvements in PA levels, followed by diabetes (ES 0.49) and cardiac disease (ES 0.40) [22]. The smallest ES for (type of intervention) was in people with cancer (ES -0.03) [22]. Patient education interventions targeting only PA were found to be more effective than interventions addressing a number of health behaviours simultaneously [22]. Supervised exercise was not found to be more effective than educational or motivational sessions. Studies utilizing behavioural strategies, such as feedback, goal setting and self-monitoring to increase PA reported larger ES than those that did not [22]. While this growing body of literature is able to provide guidance on the most effective intervention delivery modes, accessing and engaging people with chronic disease in interventions to increase PA becomes the next challenge.

1.3 Gaps and opportunities

1.3.1 Physical activity interventions in the healthcare setting

Older adults with mobility restrictions or health problems may need the support of health professionals to become more physically active and the healthcare system can be an important vehicle for promoting PA in these populations [31, 32]. To date, guidelines and reviews of interventions to increase PA in the healthcare setting have predominantly focused on their delivery in primary care. Primary care refers to health care provided in the community, as the first point of contact for people seeking advice on prevention and management of disease [2], primary care encompasses care provided by general practitioners, nurses, dentists, pharmacists and allied health practitioners. The National Institute for Health and Care Excellence (NICE) published its 2013 guidelines recommending that primary care practitioners deliver tailored, 'brief' PA advice to inactive adults, and follow this up at subsequent appointments [33]. They defined 'brief advice' as: "verbal advice, discussion, negotiation or encouragement, with or without written or other support or follow up. This may vary from basic advice to a more extended individually focused discussion" (page 7) [33].

Brief interventions to promote PA in the primary care setting have achieved small to medium improvements in self-reported PA in the short-term, however there is insufficient evidence for their long-term effect [17, 34, 35]. These interventions typically include one or more face-to-face sessions of advice or counseling on PA. The provision of written PA prescriptions has been demonstrated to enhance verbal advice in some studies, and multi-component interventions including behavioural strategies, in addition to supervised exercise and provision of equipment, have been more effective than

advice alone [17]. Primary care studies to date have relied heavily on self-reported PA measures, which have been demonstrated to both over and under estimate actual PA levels [36]. It is unclear what the impact of brief PA interventions in primary care is on objectively measured PA. Further research is required using objective PA measures. There is also insufficient evidence regarding the factors that influence the effectiveness of PA interventions in primary care, their feasibility, acceptability and which populations are most likely to benefit [35]. A review examining the cost effectiveness of primary care delivered brief interventions to increase PA found that they can achieve a meaningful increase in PA at a "reasonable cost", and concluded that when long-term health benefits and costs are considered they are cost effective [14]. Their affordability allows brief interventions to be implemented at scale, and they have been shown to be as effective as some potentially costly interventions such as exercise referral schemes [34]. Their relative success in primary care, and affordability, make brief interventions to increase PA an attractive option for applying and testing in alternate health care settings.

The definition of 'brief intervention' applied in brief intervention research varies widely in terms of intervention duration and number of follow up sessions. Brief interventions in studies included in the primary care reviews range from two to three minutes in duration to 30 minutes, with some including multiple phone call follow-up [35]. The feasibility of delivering some of the described brief interventions in a primary care consultation has been questioned [35], with the recommendation that future research in this setting needs to focus on interventions that are 'very brief' in nature (five minutes or less) due to time constraints in this setting [35]. WHO's '*Global Action Plan on*

Physical Activity 2018-2030' highlighted the need to also use trained health, community and social care providers, in secondary healthcare and social services, to deliver counseling on increasing PA and reducing sedentary behaviour. Healthcare settings other than primary care may offer the potential to reach older adults and those with chronic disease during times of health crisis and recovery, where new motivation may exist to engage in PA counseling and with access to trusted, skilled clinicians. There are presently no reviews that evaluate the evidence for the implementation of brief interventions to increase PA exclusively in healthcare settings other than primary care.

In Victoria, Australia, community rehabilitation programs provide short-term rehabilitation to community dwelling adults and older adults following a change in their health status. Referral pathways, diagnosis and rehabilitation program features are described in Figure 1.2.

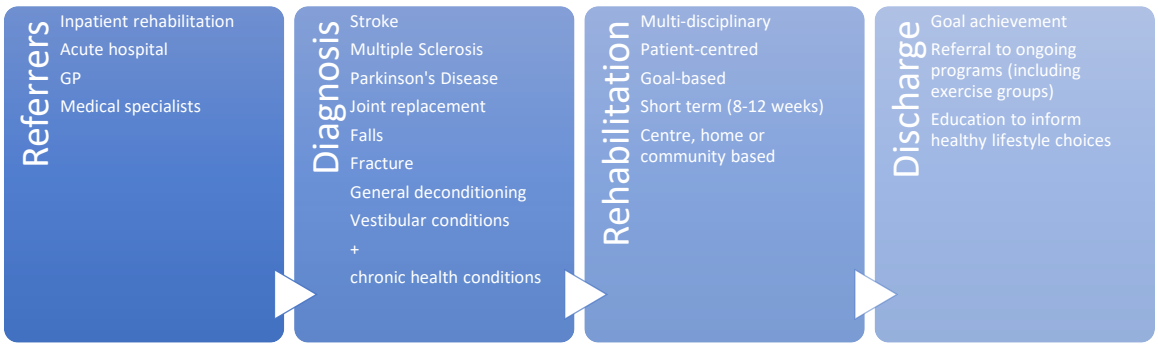

Figure 1.2 Community rehabilitation pathway

Most community rehabilitation attendees work with a physiotherapist as many have goals to improve their ability to walk safely in both their home environment and the community. Physiotherapists typically encourage ongoing PA at the completion of a client's rehabilitation program and offer referral to community-based exercise groups. Some also educate clients about the benefits of PA. The achievement of a clients' rehabilitation goals marks an ideal time to promote and support the adoption of healthy lifestyle choices. In cardiac and pulmonary rehabilitation programs much research has been undertaken to address this aim [37]. However, no formal, evidence-based, program is in place to promote the adoption of long-term PA following community rehabilitation. The body of work this thesis presents, acknowledges the substantial opportunity that exists in the context of community rehabilitation, to deliver an evidence-based intervention to increase PA in a population of predominantly older adults and adults with chronic disease, who are vulnerable to the effects of a sedentary lifestyle.

1.4 Study design

1.4.1 Systematic review

Chapter two of this thesis consists of a systematic review, which aims to investigate the effect of a brief intervention to promote PA, when delivered in a healthcare setting other than primary care. To ensure the systematic review was conducted and reported at a high quality, the study design was based on PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. As randomised controlled trials

(RCTs) form the gold standard for research in this field, the systematic review included only RCT's. To ensure robust methodology, a comprehensive search strategy was applied, and two independent reviewers selected articles for inclusion. Chapter two provides greater detail into the methodology and outcomes of this review.

1.4.2 Feasibility study

The study presented in chapter three of this thesis, was designed to test the feasibility of delivering an intervention to increase PA to the community rehabilitation population. There is considerable diversity in the community rehabilitation population, in age, functional ability, medical diagnosis and background, conducting research in such clinically heterogeneous populations has a range of challenges. Therefore, we decided to conduct a feasibility study, to test the suitability and acceptability of the selected intervention, outcome measures and study design, to lay the foundation for future research in this field. Feasibility was tested in a number of ways; firstly through identifying the level of suitability and interest in an intervention to promote PA among community rehabilitation attendees and by tracking retention rates in those recruited to the trial. To identify participant factors which may impact feasibility, readiness for change in relation to PA, was measured with a stage-of-change for exercise scale. Measuring the participant's stage-of-change in relation to PA, enables us as researchers to understand whether individuals have intention to change their behaviour and whether an intervention may therefore be useful to facilitate change. Finally, qualitative feedback via participant interview was crucial to appreciate the level of understanding and acceptability of the intervention delivered among those who received it.

Given RCTs are the gold standard for interventions in this field,this study design was applied to the feasibility study. Participants were randomised to receive either the intervention to promote PA or a control condition. Control group participants were given written educational material without verbal advice, as this provided a realistic comparison for the clinical setting i.e. was the intervention more palatable than being handed a brochure? To control for the broad age range within the community rehabilitation population, we stratified the randomisation schedule by age, to ensure an even representation of adults (≤64 years) and older adults (>64 years) in the intervention and control groups. For this feasibility study, a sample size of 40 was selected to ensure that both representation of each diagnostic group and a diverse range of ages was included in each group.

For research translation, it was imperative to select an intervention that would be able to be delivered within the scope and resources of this healthcare setting. Following a review of the literature as outlined above, a brief intervention to promote PA was designed incorporating the elements listed in Figure 1.3. To tailor the intervention to stage-of-change in relation to PA, intervention discussion points for each stage were set based on behaviour change literature for older adults [28]. To ensure consistency in the delivery of the intervention, we had one primary researcher deliver all of the interventions, as opposed to each participant's treating therapist delivering the intervention protocol. Given the delivery of the intervention could impact it's feasibility, it was important that it was delivered in a relatively uniform manner.

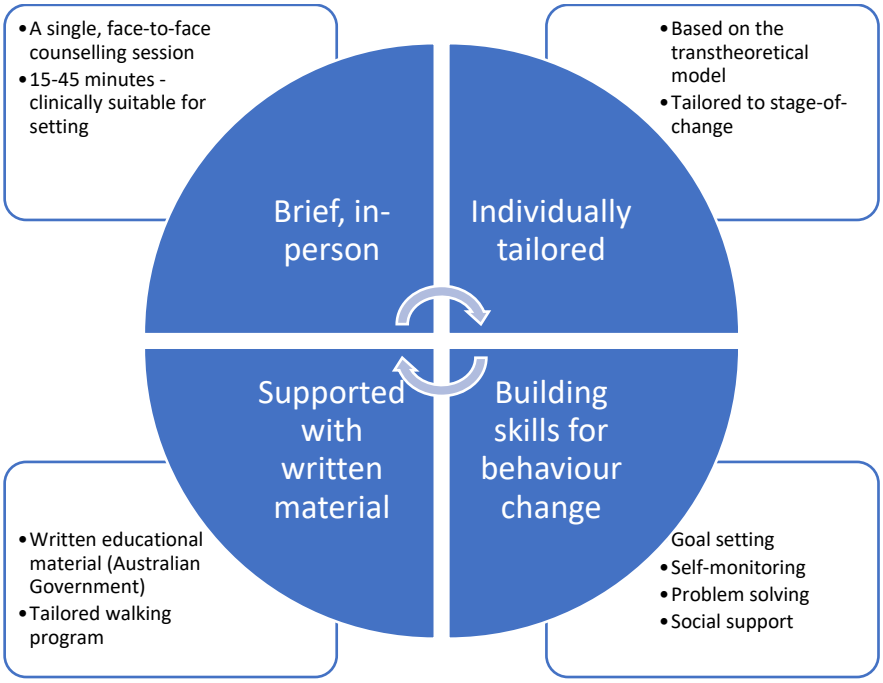

Figure 1.3 **Design of an intervention to promote PA in community rehabilitation**

Feasibility, as described above was the primary outcome of this study, it was important however to also test the acceptability and applicability of relevant secondary outcome measures. We selected to assess PA participation objectively via a wrist worn accelerometer. Objectively measured PA has been documented to be more reliable in accurately measuring PA than self-reported measures, which have been observed to both under and over-estimate activity [36]. In addition, quality of life and a self-efficacy for exercise questionnaires were utilized at baseline and follow up. Improving an individual's quality of life is an overarching aim of health promotion activities and self-efficacy for exercise is one of the most consistent predictors of exercise adherence [38] and was therefore important to include. A follow up period of three months post intervention delivery was selected, while this only assessed relatively short-term outcomes, this was deemed suitable given the study was primarily assessing feasibility of

intervention delivery. To minimise potential bias, the follow up outcome assessor was blind to group allocation and the researcher completing the participant interview, to seek feedback on the intervention delivered, was not the same researcher who delivered the intervention.

Participants attending the centre-based arm of a community rehabilitation program in Melbourne, Australia, were invited to take part in this study. Those attending the home-based arm of the same service were not invited due the additional time and resources required to attend each participant's home for each point of contact. Other potential participants excluded from the study include those who; were non-ambulant, had medical or safety issues preventing them from safely participating in regular PA, had cognitive impairment (Mini Mental State Examination <24 or diagnosis of dementia) or were unable to read and speak English. Being an education and counselling intervention, participant's ability to understand both the consent form and the intervention itself was crucial for determining feasibility. Further, participants' ability to safely engage in PA, as recommended in the intervention, was also essential.

1.5 Aims of thesis

The overall aim of this thesis was to identify opportunities to optimise PA of clients being discharged from community rehabilitation.

More specifically, this thesis aimed to:

1. Understand the effect of brief interventions to increase PA, when delivered in the health care setting

2. Test the feasibility of delivering a brief intervention to increase PA in the community rehabilitation context.

1.5.1 Thesis Overview

Chapter two is a systematic review examining the effects of brief interventions to increase PA, when delivered in healthcare settings other than primary care (submitted for publication Patient Education and Counseling).

Chapter three presents a randomised controlled trial, testing the feasibility of delivering a brief intervention to increase PA in a community rehabilitation population (published Journal of Aging and Physical Activity, December 2021).

Chapter 2: Systematic review

Declaration for thesis Chapter Two, which was submitted to *Patient Education and Counseling* 10/02/2022:

Green, E T., Cox, N S., Warren, C J., Arden, C M., Holland, A E. What is the effect of a brief intervention to promote physical activity when delivered in a healthcare setting? A systematic review.

The nature and extent of my contribution to the work in Chapter Two was the following:

Nature of contribution	**Extent of contribution**
Principle author responsible for the concept, design, statistical analysis, manuscript development and writing.	80%

The following co-authors contributed to the work. There are no student co- authors.

Name	**Nature of contribution**
Narelle S Cox	Assisted with concept, design, statistical analysis, manuscript development and writing.
Clare M Arden	Assisted with manuscript development and writing.
Cathy J Warren	Assisted with manuscript development and writing.
Anne E Holland	Assisted with concept, design, statistical analysis, manuscript development and writing.

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the candidate's and co-authors' contributions to this work.

Candidate's Signature: Emily Green Date: 15/02/2022

Main Supervisor's Signature: Anne Holland Date: 16/02/2022

What is the effect of a brief intervention to promote physical activity when delivered in a healthcare setting? A systematic review.

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What is the effect of a brief intervention to promote physical activity when delivered in a healthcare setting? A systematic review.

Abstract

Objective: To investigate the effect of a brief intervention to promote physical activity (PA), when delivered in a healthcare setting other than primary care.

Methods: MEDLINE, EMBASE, CINAHL, PsycINFO were used to identify randomised controlled trials which evaluated the effect of brief interventions to increase PA, delivered in a healthcare setting. Review outcomes included subjectively or objectively measured PA, adherence to prescribed interventions, adverse events, health-related quality of life, self-efficacy and stage-of-change in relation to PA. Where possible, clinically homogenous studies were combined in a meta-analysis.

Results: 25 eligible papers were included. Brief counseling interventions were associated with increased PA compared to control, for both self-reported PA (mean difference 54 minutes/week, 95% CI 13 to 95 minutes), and pedometer (MD 1541 steps/day, 95% CI 433 to 2649) at medium term follow-up.

Conclusion: Our findings suggest that some brief interventions to increase PA, delivered in the healthcare setting, are effective at increasing PA in the medium-term.

Practice Implications:

Brief counseling interventions delivered in a healthcare setting may support improved PA, however the wide variation in types of interventions makes it difficult to determine which intervention features optimise outcomes. There is limited evidence for the long-term efficacy of such interventions.

2.1 Introduction

Physical inactivity is estimated to be responsible for up to 10% of the major non communicable diseases worldwide, including coronary heart disease, type 2 diabetes, breast and colon cancers, and responsible for 9% of premature mortality [1]. While there is overwhelming evidence that regular physical activity (PA) has important and wide-ranging health benefits, more than half of Australian adults do not meet PA guidelines [2]. For those aged over 75 years only 25% meet PA recommendations [2], despite older adults having much to gain from remaining active in terms of disease prevention and maximizing functional independence [3]. Those who suffer from chronic disease, such as osteoarthritis [4], stroke [5], spinal cord injury [6] and Multiple Sclerosis [7] are also less likely to participate in regular PA. However, PA is particularly important for adults with chronic illnesses, for delaying illness progression or managing symptoms [8].

Efforts to increase population PA levels have been widely studied and effective interventions have been identified in a range of different populations, including older adults and those with chronic disease. Health coaching has been demonstrated to have a small effect on PA in people over 60 years old [3]. While a systematic review of interventions to increase PA in community-dwelling older adults found interventions tested among healthier subjects had larger effects than those tested among chronically ill populations [9]. Education interventions to increase PA in adults with chronic illness have been demonstrated to be moderately effective, however considerable heterogeneity was noted in the magnitude of the intervention effect between studies [10].

Physical activity counseling can also support increased PA, and ideally takes place “in settings with the chance to reach ‘difficult’ subgroups of sedentary adults” (p375) [11]. Brief interventions involve verbal advice or encouragement, varying from basic advice to more detailed counseling, and are typically delivered face-to-face, over one or more sessions [12, 13]. To date, systematic reviews regarding brief PA intervention programs within the healthcare system are predominantly limited to interventions delivered in primary care. A systematic review examining nutrition and PA counseling interventions to reduce cardiovascular disease risk, delivered almost exclusively in primary care, reported a modest increase in PA with intervention compared to no-intervention or usual care control groups [14]. While primary care studies have shown that brief physician advice can increase PA levels moderately in the short-term [15, 16], long-term results have been less promising [17]. Healthcare settings other than primary care may also offer the potential to reach these ‘difficult subgroups’ during times of health crisis and recovery, where new motivation may exist to engage in PA counseling and with access to trusted, skilled clinicians. However, the effect of brief interventions to promote PA when delivered in alternative healthcare settings, or by health professionals other than primary care practitioners, remains unclear.

The aim of this systematic review was to investigate the effect of a brief intervention to promote PA, when delivered in a healthcare setting other than primary care. The review objectives were to describe the types of brief interventions to promote PA delivered in a variety of healthcare settings; and, to examine the effectiveness of these brief interventions in patients accessing the healthcare system, including the elderly and those with chronic illness.

2.2 Method

2.2.1 Criteria for considering studies for this review.

2.2.1.1 Types of studies

Randomized controlled trials (RCTs) and cluster-RCTs published in peer reviewed journals were considered for inclusion. Only journals published in English language were considered due to resource limitations. No publication date restrictions were imposed.

2.2.1.2 Types of participants

Studies that included adults, aged over 18 years, being managed in a healthcare setting, were the target population for this review. Studies of populations including both children and adults were considered, provided at least 80% of the participants were aged over 18 years. Studies whose participants had pre-existing medical conditions were included, provided they remained able to participate in PA. Studies of adults who were unable to participate in PA due to medical conditions were excluded.

2.2.1.3 Types of interventions

This review investigated brief counseling interventions, employed to promote increased participation in daily PA, when delivered from the inpatient or outpatient healthcare setting. Studies conducted in primary care or non-clinical community settings were excluded, as these contexts have been studied in previous reviews [13, 18, 19].

For the purpose of this review 'brief interventions' were defined according to the NICE guidelines [12] for 'brief advice', being: "verbal advice, discussion, negotiation or encouragement, with or without written or other support or follow-up. This may vary from basic advice to a more extended individually focused discussion". While brief

interventions are typically of 5-30minutes duration [13], 'brief interventions' of longer than this duration were not excluded. Studies were excluded if the intervention included more than three face-to-face sessions. Interventions including PA advice in combination with other education and lifestyle advice were included.

2.2.1.4 Types of outcome measures

The primary outcome of this review was PA level. Studies were included if they measured PA levels either subjectively (i.e. self-report or activity diary) or objectively (i.e. activity monitor or pedometer), as a primary or secondary outcome. Measures of PA included, but were not limited to, total energy expenditure (i.e. Calories or joules), total minutes of PA/week or intensity of PA (i.e. activity monitor or self-report).

Studies were not excluded in relation to length of follow-up, rather they were categorized based on time-points for follow-up measures. Those with follow-up of up to one month were classified as short-term; greater than one month up to 6 months were classed as medium-term; and greater than six months were classed as long-term follow-up.

Secondary outcomes included: adherence to prescribed interventions; adverse events; health-related quality of life; self-efficacy and stage-of-change in relation to PA, as measured by standardized assessment tools. Adverse events comprised musculoskeletal injuries, falls, injuries as a result of a fall (i.e. fractures or sprains), cardiovascular events and death.

2.2.2 Search Strategy

The following electronic health science databases were searched for original research articles published between database inception and 2nd January 2022: MEDLINE, EMBASE, CINAHL and PsycINFO. The search strategy, tailored for each database (see supplementary material 1), consisted of two filters; PA terms (e.g. exercise) and brief intervention terms (e.g. minimal intervention). Results were limited to English language. The reference lists of included studies were also searched for articles suitable for inclusion.

2.2.3 Study selection

One reviewer (EG) ran the electronic searches, downloaded references and removed duplicates. Two independent reviewers (EG and CA/CW) analysed all titles and abstracts to determine whether the studies met the eligibility criteria. Disagreements over eligibility were resolved via discussion and consensus, with a third author available for arbitration if necessary. Full texts were accessed for those studies deemed eligible, or if insufficient information was available to apply eligibility criteria based on the study abstract. If a lack of clarity remained, reviewers contacted the relevant study author to seek clarification. In the case of duplicate publications or the same research appearing in two different journals, the study was counted as a single piece of research.

2.2.4 Data extraction

The data extraction tool utilized was a modified version of the Cochrane Group 'Data collection form for intervention reviews: RCTs only' [20]. Data extracted included participants' demographic details, study setting, intervention type and mode of delivery, frequency and duration of the intervention, details of the control arm of the trial and

outcomes reported. The primary investigator extracted the data and a second reviewer verified this, with disagreements resolved via discussion and consensus, with the option to consult a third reviewer as required.

2.2.4.1 Assessing for risk of bias

Two reviewers independently assessed the quality and risk of bias of included studies. Risk of bias was evaluated using the Cochrane Risk of Bias tool [20], under the headings of random sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting and other potential bias. A sensitivity analysis was performed excluding studies at high risk of bias for the domains of allocation concealment and assessor blinding.

2.2.5 Data analysis

2.2.5.1 Measures of treatment effect

Where populations, interventions and outcomes were considered by the authors to be clinically homogenous and outcomes were measured on the same scale and reported at the same time point, a meta-analysis was performed using Cochrane statistical package RevMan 5.4.1 [21]. For continuous outcomes, where studies used the same scale to assess the same outcome, treatment effects are expressed as mean differences and 95% confidence intervals.

2.2.5.2 Assessment of heterogeneity

Heterogeneity between studies was determined using the standard Chi2 test and I^2 statistics. Authors considered $I^2 < 49\%$ as low heterogeneity, 50-74% as moderate heterogeneity and 75-100% as high heterogeneity. If there was low heterogeneity, we used a fixed-effects model. If heterogeneity was moderate or high we explored the reasons for this. If data were considered similar, we applied a random-effects model, if not, we did not pool data.

2.2.5.3 Sub-group analysis

A subgroup analysis was performed of inpatient versus outpatient populations.

We planned to conduct further subgroup analyses, examining the effects of the intervention on adults (18-65 years) compared to older adults (>65 years), and

comparing modes of intervention delivery, however missing data and inconsistent methods of reporting between included studies precluded this from occurring.

2.3 Results

2.3.1 Study identification and selection

A total of 1,360 studies were identified through database searching after removing duplicates. Reference list searching identified 64 additional records. After screening 61 full text papers, 25 reports representing 24 RCTs, met the inclusion criteria and were included in the review. Flow of studies through the review and reasons for study exclusion are detailed in Figure 2.1.

2.3.2 Study description

Table 2.1 summarises the characteristics of included studies. Eight studies were conducted in the USA [22-29], six in Australia [30-35], four studies were based in the UK [36-39], four in Germany [40-43], one in each of Canada [44], Poland [45], and New Zealand [46]. In all included studies, the experimental group received a brief PA counseling session based on behaviour change principles, including some or all of the following elements: education; exercise prescription; goal setting; problem solving to overcome barriers to PA; behavioural reinforcement; and consideration of social supports. Six studies used pedometers [30, 32, 38, 39, 44, 47] and seven used exercise diaries [27, 30, 32, 40, 42, 45, 47] to encourage self-monitoring. Seven studies included dietary advice alongside PA counseling [25, 26, 28, 33, 36, 37, 44].

Thirteen studies examined a single session brief intervention [23-26, 28, 29, 34, 35, 41-43, 45, 46], with four of these using technology for delivery [25, 26, 29, 46] (i-pad, DVD,

computer program). Nine studies included a single brief counseling session with follow-up by either mail or phone call [22, 27, 30-33, 36, 37, 40]. Three studies involved two in-person counseling sessions [38, 39, 44]. The brief counseling sessions in the included studies ranged in duration from 5 minutes [34] up to two hours [44], with the longer session also including nutrition education and counseling. Follow-up length ranged from single session interventions with no follow-up intervention [23-26, 28, 29, 34, 35, 41-43, 45, 46] to a number of face-to-face and phone sessions over 24 weeks [37]. The mean duration of follow-up was 24 weeks. Interventions were delivered by a range of health professionals, including: public health doctoral students [22]; an exercise physiologist [23]; medical student [24]; trainee health psychologist [38, 39]; physiotherapist [34, 35, 44]; health counsellor [27]; medical assistant [28]; and, health promotion staff [30]. Ten studies [32, 33, 36, 37, 40-43, 45, 47] did not specify who delivered the intervention and four [25, 26, 29, 46] reported interventions delivered via electronic devices.

Five of the interventions were delivered in inpatient settings [33, 40-42, 46] while the remaining 20 studies were based in outpatient settings. Twenty-two trials included participants with a specific medical condition; studies were based in cardiology settings (n=10 studies) [29-33, 40-42, 45, 46], oncology clinics (n=4 studies)[22, 26, 27, 36], lower limb vascular clinics (n=3 studies) [24, 38, 39], diabetic clinics (n=2 studies) [28, 37], and single studies recruited from arthritis [44], pregnancy [25], orthopaedic [42], and alcohol dependency [23] clinics. Two trials recruited participants with mixed diagnosis [34, 35]. In 18 studies the control group received no intervention or usual care [22, 25-30, 33, 36-42, 44-46]; two of these studies [41, 42] examined two different brief PA counseling interventions against a usual care group. Two further studies [32, 35] compared a brief

PA intervention to a control group who received an educational brochure on the benefits of PA. One study [34] delivered the same very brief intervention to two groups and studied the impact of high or low outcome measurement frequency on PA outcomes, and another [43] compared a group who self-completed an activity plan with a researcher facilitated activity planning group. Three studies compared a brief PA counseling intervention to another intervention; being a disease-specific educational video [24], an aerobic exercise intervention [23] and a weight loss counseling intervention, which also included PA advice targeted to weight loss [31].

2.3.3 Outcomes

Fifteen studies measured self-reported PA minutes/day [23-25, 27, 30-32, 34, 36, 37, 40-43, 45, 46], five studies measured self-reported MET (metabolic equivalent)/day of PA [22, 26, 27, 29, 33], four studies recorded steps/day with pedometers [27, 38, 39, 44] and three studies measured PA using activity monitors [27, 34, 35]. Included studies reported the following secondary review outcomes: quality of life (n=6 studies) [22, 33-35, 38, 39, 44]; self-efficacy for exercise (n=7 studies) [29, 30, 32, 35, 41-43]; and, stage of change in relation to exercise (n=2 studies)[29, 35]. Three studies reported data on adherence to prescribed walking interventions from patient reported activity logs [22, 27, 45] with mean reported adherence ranging from 62% [45] to 94% [27]. No adverse events were reported in response to any intervention. Five studies involved long-term follow-up of participants; with follow-up ranging from twelve months [33, 37, 40, 45] up to two years [38]. The remaining studies reported medium-term follow-up, from six weeks to eight months. One study was reported across two papers, with one describing outcomes at medium-term [39] and the other long-term follow-up [38].

2.3.4 Participants

Included studies had a total sample of 3,527 participants. The mean age of participants in the included trials ranged from 26 to 72 years. Three trials included women only [22, 25, 27], the remaining trials included both men and women with women representing 51% of participants (two studies did not provide gender data).

2.3.5 Methodological quality

Figure 2.2 presents the methodological quality of the studies included in this review. All except one study [24], were scored high risk in at least one domain. Four studies [27, 40, 41, 44] were scored as high risk for random sequence generation. Blinding of participants to study group allocation was achieved in only 2 studies [24, 43], however due to the nature of the studied interventions blinding of the researcher delivering the intervention was not possible. Only 4 studies [25, 28, 34, 35] were low risk for blinding of outcome assessors to group allocation, 2 studies were high risk [30, 31], while the remaining 19 studies did not specify whether the assessor was blinded. Management of incomplete outcome data led to high risk of bias in 8 studies [26-29, 40, 41, 44, 45]. Two studies scored high risk for other potential bias, these being unequal payment of participants in each group [23] and the potential confounding influence of surgical intervention on outcomes [38]. Six authors were contacted for further information, no responses were received.

2.3.6 Meta-analysis

Data were able to be pooled for 10 studies, outcome data were not reported in 2 studies [42, 43], the remaining studies have been described narratively.

2.3.6.1 Physical activity

Short-term: No studies reported outcomes at one month or less.

Medium-term: Self-reported PA was increased following a brief counseling intervention compared to control (mean difference (MD) 54 minutes/week, 95% confidence interval (CI) 13 to 95 minutes, 5 studies, 850 participants, I^2=98%) (Figure 2.3) [25, 30, 32, 41, 46]. When studies at high risk of bias for allocation concealment and assessor blinding were excluded, there was no difference between groups for self-reported PA (MD 44 minutes/week, 95%CI -5 to 92.5 minutes, 3 studies, 438 participants, I^2=51%) [25, 32, 46]. Effects on steps/day, measured by pedometer, favoured brief PA counseling interventions (MD 1541 steps/day, 95%CI 433 to 2649, 3 studies, 117 participants, I^2=0%)(Figure 2.4) [27, 39, 44]. There was no difference between groups for self-reported MET hours/week of PA (MD 11 MET hours/week, 95%CI -17 to 40, 2 studies, 104 participants, I^2=86%) (Figure 2.5) [26, 27].

Four studies unable to be included in the meta-analysis, reported no difference between groups for PA minutes/week as a result of the brief interventions delivered [24, 34-36]. A brief phone-based intervention for PA in breast cancer survivors found intervention group participants had greater subjective energy expenditure from walking for exercise than the control group (effect size (ES) intervention = 3.07; ES control 0.18; ES between groups = 2.89) at 12-week follow-up [22]. When studied in comparison to a weight loss phone counseling intervention in a cardiac rehabilitation population, a brief PA intervention demonstrated significant within group changes for self-reported PA at six month follow-up (MD 80 minutes/week, 95% CI 39 to 120), however there was no

difference between the intervention groups (p=0.15)[47]. When studied alongside an aerobic exercise intervention in an alcohol dependency clinic, a brief intervention demonstrated a within group change in median self-reported PA minutes/week from 94 minutes (interquartile range (IQR)= 0-158) at 12 weeks to 130 minutes (IQR 89 to 282) at 6 months [23], however there was no difference between groups for self-reported PA.

Long-term: Two brief interventions in the cardiac rehabilitation setting reported greater PA at 12 months in response to the intervention. In one study intervention group participants self-reported a mean 117 (standard deviation (SD) 124) minutes/week of PA compared to a no-intervention control group (56 (SD 97)minutes/week; t=2.94, p<0.01)) [40]. In another study, mean PA time at 12-months was 2.8 hours/week for the intervention group versus 2.2 hours/week for the no-intervention control group [45]. A third study [33] in a coronary care setting also demonstrated self-reported improvement in PA following a brief face-to-face and phone call intervention (mean 1369 (SD 167) METS/kg/min) compared to a usual care control group (mean 715 (103) METS/kg/min; ES 654 (95%CI 264 to 1040), p<0.001). Complete data sets were not available for meta-analysis. A single study [38] examined PA steps/day at 12 months in participants with intermittent claudication. The mean difference in daily step count at 1 year was 1374 steps (95%CI 528 to 2220) and at 2 years was 1630 steps (95%CI 495 to 2765), however changes may not all be attributable to the intervention, as 39% of intervention group participants and 67% of control group participants had also undergone revascularisation by 2 year follow-up. A final study [37] investigated a brief counseling intervention in a diabetic outpatient clinic and found no difference in PA as reported on the Physical

Activity Scale for the Elderly (PASE) questionnaire, at three or 12-month follow-up, compared to a usual care control group.

2.3.6.2 Quality of life

Short-term: No studies reported outcomes at one month or less.

Medium-term: Three studies measured general quality of life at medium-term follow-up, with no significant difference between groups (standardised mean difference (SMD) 0.34, 95% CI -0.31 to 1, 3 studies, 128 participants, I^2=69%) [34, 35, 39].

Long-term: One study assessed quality of life with the WHO-QOL BREF [39], reporting a significant between group difference in favour of the brief PA counseling group at four month follow-up (F(1,55) = 10.04 p=0.002), however the between group difference was not maintained at 1 and 2 year follow-up. A brief intervention delivered in the coronary care setting [33] was demonstrated to improve quality of life as measured using the physical functioning domain of SF-36 at 12 month follow-up (mean 76 (SD 2.7), compared to control 64.3(2.8), p<0.01).

2.3.6.3 Self-efficacy for exercise

Short-term: No studies reported outcomes at one month or less.

Medium-term: Three studies examined self-efficacy for exercise at baseline and follow-up on 5- [29] and 10-point self-report scales [30, 35], however there was no significant difference between groups (MD 0.36, 95% CI 0 to 0.73, 3 studies, 321 participants, I^2=13%) [30, 34, 35].

Long-term: No studies measured long term changes to self-efficacy for exercise.

2.3.6.4 Stage of change for exercise

Short-term: No studies reported outcomes at one month or less.

Medium-term: Two study measured stage of change in relation to exercise at medium term follow-up. Neither study [29, 35] demonstrated progression in stage of change for the brief intervention group, on the contrary both studies saw control group participants progress in stage of change in comparison to the intervention groups. Data were not able to be pooled for this outcome.

Long-term: No studies examined stage of change outcomes long-term.

2.3.7 Subgroup analysis

A subgroup analysis was conducted to examine the effect of brief PA counseling on PA minutes/week in inpatient and outpatient study populations, when compared to a usual care control group, at medium-term follow-up. No between group difference was noted for inpatient [41, 46] (MD 52 minutes/week (95%CI -2 to 107 minutes), 2 studies, 272 participants, I2=99%) or outpatient data [25, 30, 32] (MD 56 minutes/week (95% CI -5 to 116) 3 studies, 578 participants, I2=63%). Heterogeneity of results was moderate to high.

2.4 Discussion

In this systematic review and meta-analysis, we found some evidence that brief PA counseling, when delivered to adults in a healthcare setting, was effective at increasing PA in the medium-term. The brief PA counseling interventions examined led to an

increase in mean self-reported PA of 54 minutes/week and mean steps/day of 1541 when compared to a usual care control group at medium term follow-up. These findings are consistent with a systematic review examining brief PA interventions in the primary care setting [48], which concluded that brief PA interventions can increase self-reported PA in the short term, with insufficient evidence regarding their long-term impact.

The findings from this review demonstrate that the definition of 'brief intervention' is broad, with significant variation between included studies in duration of intervention (15 minutes to two hours). Six studies included in this review [26, 28, 33, 36, 38, 39, 44] examined 'brief interventions' which included longer face-to-face sessions of between one and two hours in duration. There was a tendency for these longer intervention sessions to have less intensive or no follow-up, leading to their description as 'brief interventions'. Of these studies, three delivered a treatment targeting both dietary and PA advice [28, 36, 44] and a fourth included a broader range of education topics [33] within the allocated intervention time. Other reviews conducted in primary care [13, 48] have also found variation in the interpretation of 'brief intervention' in included studies. These primary care reviews reported on brief interventions up to 30 or 40minutes in length, however some of the included interventions had a considerable amount of follow-up after the brief initial session. The use of follow-up beyond the face-to-face intervention may serve to aid participant recall and compliance with advice. The present review found substantial variability in the use of, method, frequency and length of follow-up after an initial face-to-face session, ranging from no follow-up to five 15-minute telephone calls over 12 weeks [22, 27]. A primary care-based review reported inconclusive evidence on the impact of duration of individual sessions on self-reported

PA [48], while also reporting that the use of follow-up sessions might be more important for effectiveness than initial session duration [48].

We found a wide variation in brief PA counseling delivery methods, including face-to-face, electronic (iPad, DVD, computer program) and telephone, with some studies using a combination of these modes of delivery. A number of interventions also included self-monitoring tools like pedometers or walking diaries, and some interventions were supplemented with written information. Because there were too few trials with similar intervention components to pool results, it was not possible to determine if there is any one type of counseling delivery method or self-monitoring tool that is more effective than another. A review on the effect of health coaching on PA participation in people aged 60 years and over, found telephone delivered interventions to have a small impact on PA (SMD=0.21; 95%CI 0.11 to 0.32; p<0.001), compared to face-to-face interventions, which demonstrated a larger pooled effect (SMD=0.41; 95%CI 0.25 to 0.58; p<0.001) [3]. The population included in this large review was recruited from community settings and a range of primary and other healthcare settings, including participants with a range of chronic diseases, meaning these findings may be generalizable to the population studied in this present review. Another review examining the effect of interventions to increase PA in older adults identified several intervention delivery characteristics which positively impact effectiveness, including use of audio-visual media, mailed materials, theoretical basis and a combination of cognitive and behavioural strategies [9]. While included studies examined both healthy and chronically ill older adults, the interventions studied were more time and session intensive than the brief interventions included in our

present review. Whether these intervention characteristics would have similar effect when used in conjunction with brief interventions remains unclear.

Opportunity exists within the healthcare setting to target PA interventions to populations vulnerable to inactivity. Further, there is the potential to time intervention delivery during an optimal stage of an individual's health journey as well as to harness existing trust, rapport, and expertise to deliver PA interventions. In primary care and the community, brief interventions promoting PA have been demonstrated to be cost-effective [13] and their brief nature makes them more feasible to deliver within resource constraints than more intensive interventions. While the current evidence base supports the use of brief PA interventions in primary care [49], consultations in these settings are time-limited and one systematic review has identified that many of the brief interventions the literature is based on are too long to be practically conducted in a primary care consultation [48]. Evidence to support the use of brief PA interventions in a broader range of settings, and by a range of different health professionals, will increase opportunities for their impact.

Strengths & limitations

This systematic review is the first, to our knowledge, to explore the effect of brief counseling interventions to increase PA, when delivered exclusively in healthcare settings other than primary care. Strengths of this review include its robust methodology, being conducted in accordance with the PRISMA guidelines, and including a comprehensive search strategy determined a priori, no limitations according to date of publication, and the inclusion of only RCT's. However, this review also has several

limitations. Due to the broad nature of the inclusion criteria, target populations and intervention settings included in this review are varied, which may limit the ability for findings to be generalized. Furthermore, most of the studies delivered disease specific education, some in conjunction with a new diagnosis when the participant may be more motivated for behaviour change for PA. Results must, therefore, be generalized with caution. Only five studies [33, 37, 38, 40, 45] examined the long-term impacts of the described brief interventions on PA. While unable to be pooled in a meta-analysis, three studies did demonstrate improved PA outcomes for interventions delivered following acute coronary care or cardiac rehabilitation. As cardiac rehabilitation has a strong evidence base, this will usually be the gold standard recommendation for many people admitted with acute coronary syndrome or post cardiac surgery. In this setting, brief interventions may be a useful adjunct to cardiac rehabilitation to increase PA participation. For those unable to attend or participate in cardiac rehabilitation however, brief interventions may provide a useful alternative. Further high-quality research is required to investigate the long-term effect of brief PA interventions when delivered in a variety of healthcare settings. This is consistent with findings in the primary care setting [48]. Too few studies examined the secondary outcomes of interest in this review to pool data for analysis.

This review was impacted by missing data and inconsistent methods of reporting among included studies. Despite attempting to contact relevant authors, necessary data were not available for a number of studies. Reliance on self-report PA measures in many included trials introduces the potential for recall bias. Self-reported measures have been demonstrated to both over and underestimate PA levels when compared to objective

measures [10]. In addition, the nature of the included studies made it difficult to conceal participant knowledge of group allocation. This lack of blinding combined with the use of self-report PA measures, leaves studies susceptible to the Hawthorne effect whereby participants may alter their response due to the knowledge they are being observed [50]. Pooling data were only possible for a small number of studies, in many cases heterogeneity was high, due to significant variation between populations studied and intervention characteristics. Further research is needed, using robust methodology, objective measures of PA and long-term follow-up, to determine the impact of delivering brief counseling interventions in the healthcare setting to increase PA participation.

2.5 Conclusion

Our results provide evidence that some brief interventions to increase PA, when delivered in the healthcare setting, are effective at increasing PA in the medium-term. Further evidence is required regarding the efficacy of such interventions in the long-term. These results are generalizable to adults and older adults with medical conditions, being treated in a variety of inpatient and outpatient settings outside of primary care. We were unable to determine the factors which impacted the success of these interventions. Further high-quality research is required that applies a consistent definition of 'brief intervention', to determine the optimal method of delivery, length and type of follow-up and harnessing the use of objective PA measures.

2.5.1 Practice Implications

The healthcare system offers valuable opportunity to reach adults at risk of physical inactivity. Clinicians in this setting must consider the implementation of interventions to

increase PA in vulnerable patient groups, including the elderly and those with chronic illness. This review found that some brief interventions to increase PA, when delivered in the healthcare setting, are effective at increasing PA in the medium-term. However, it is unclear which delivery characteristics optimise the effectiveness of brief PA interventions or which populations are most likely to benefit, necessitating further research.

Conflict of interest statement

The authors declare that they have no conflicts of interest.

Confidentiality statement

I confirm all patient/personal identifiers have been removed or disguised so the patient/person(s) described are not identifiable and cannot be identified through the details of the story h in this setting.

Authors contributions

ETG, AEH and NSC contributed to the review design. ETG executed the search strategy and completed the data extraction of included studies. ETG, CMA and CJW screened search results and assessed studies for inclusion. ETG and CJW completed reference list screening and risk of bias assessments, CMA and CJW completed risk of bias assessment for the study published by ETG, NSC and AEH. CJW double checked the data extraction. ETG, AEH and NSC interpreted the findings. All authors contributed to the manuscript, read, and approved the final manuscript.

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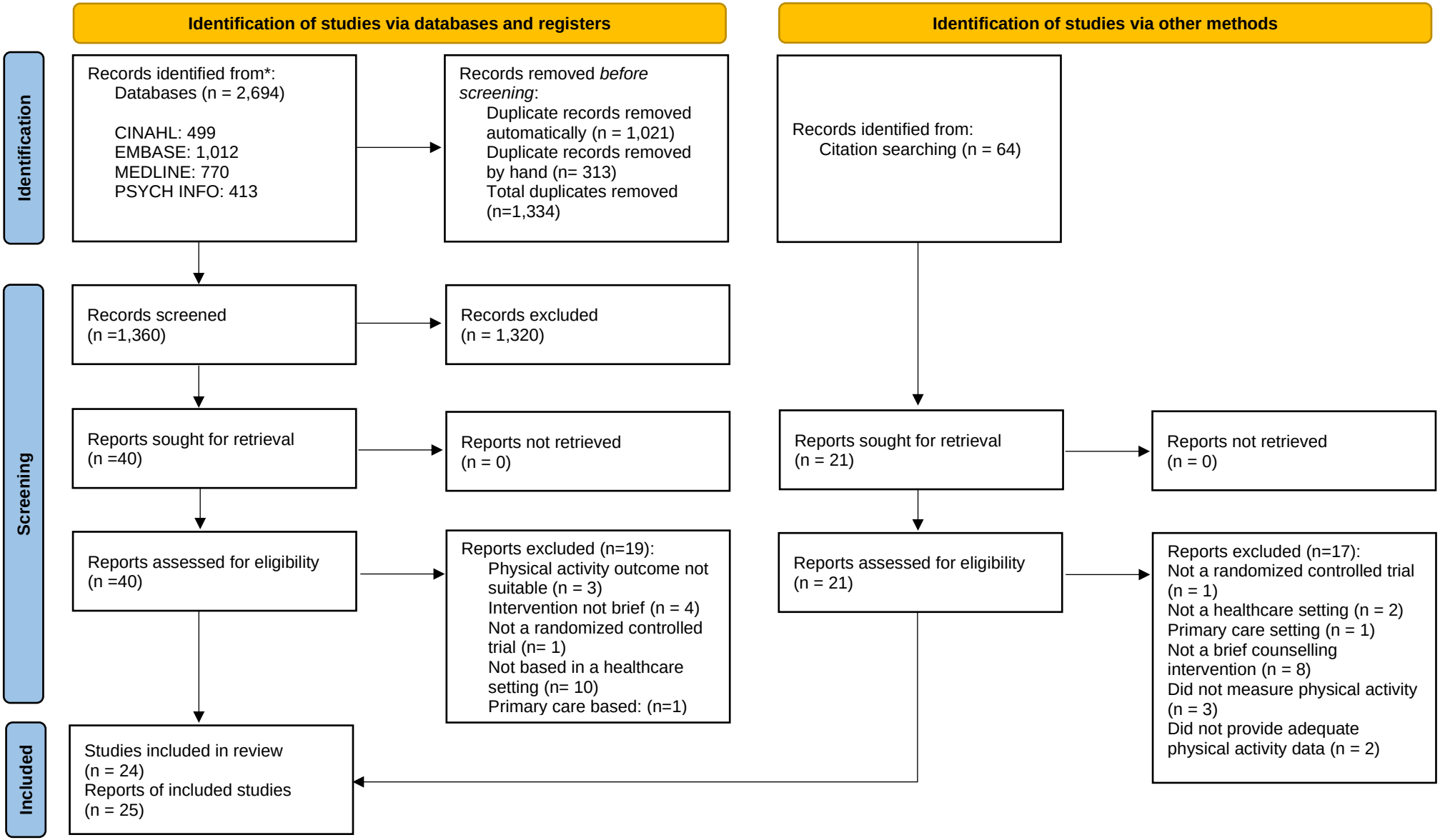

Figure 2.1 PRISMA flow diagram

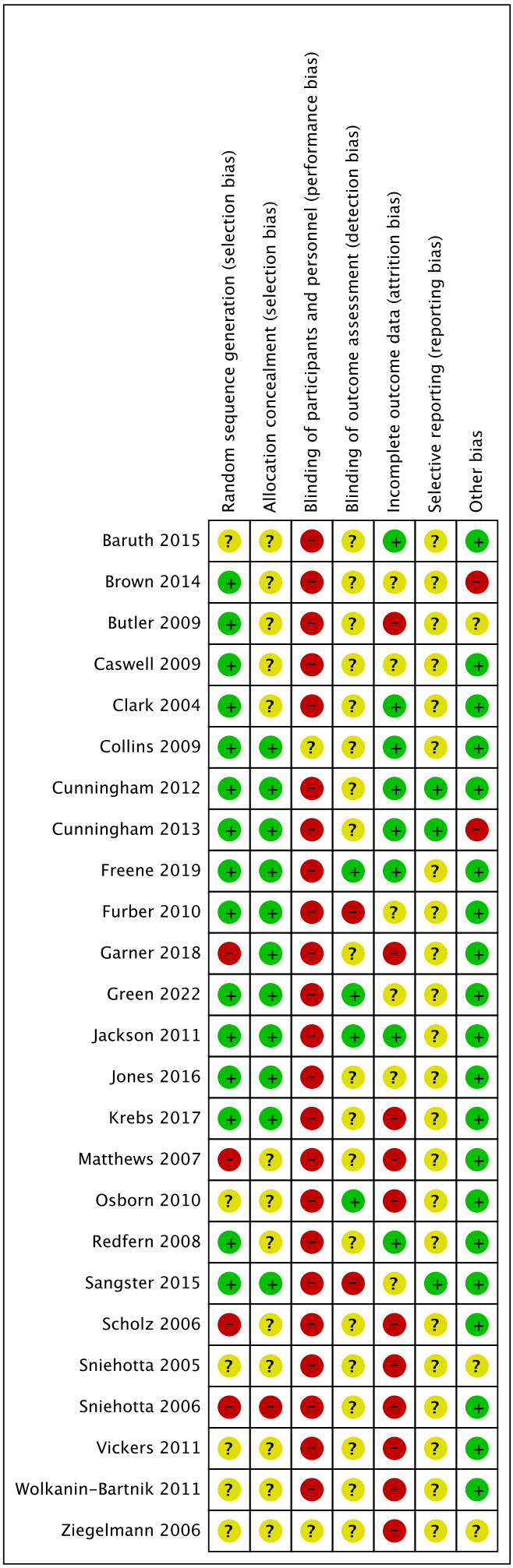

Figure 2.2

Risk of bias summary of included studies

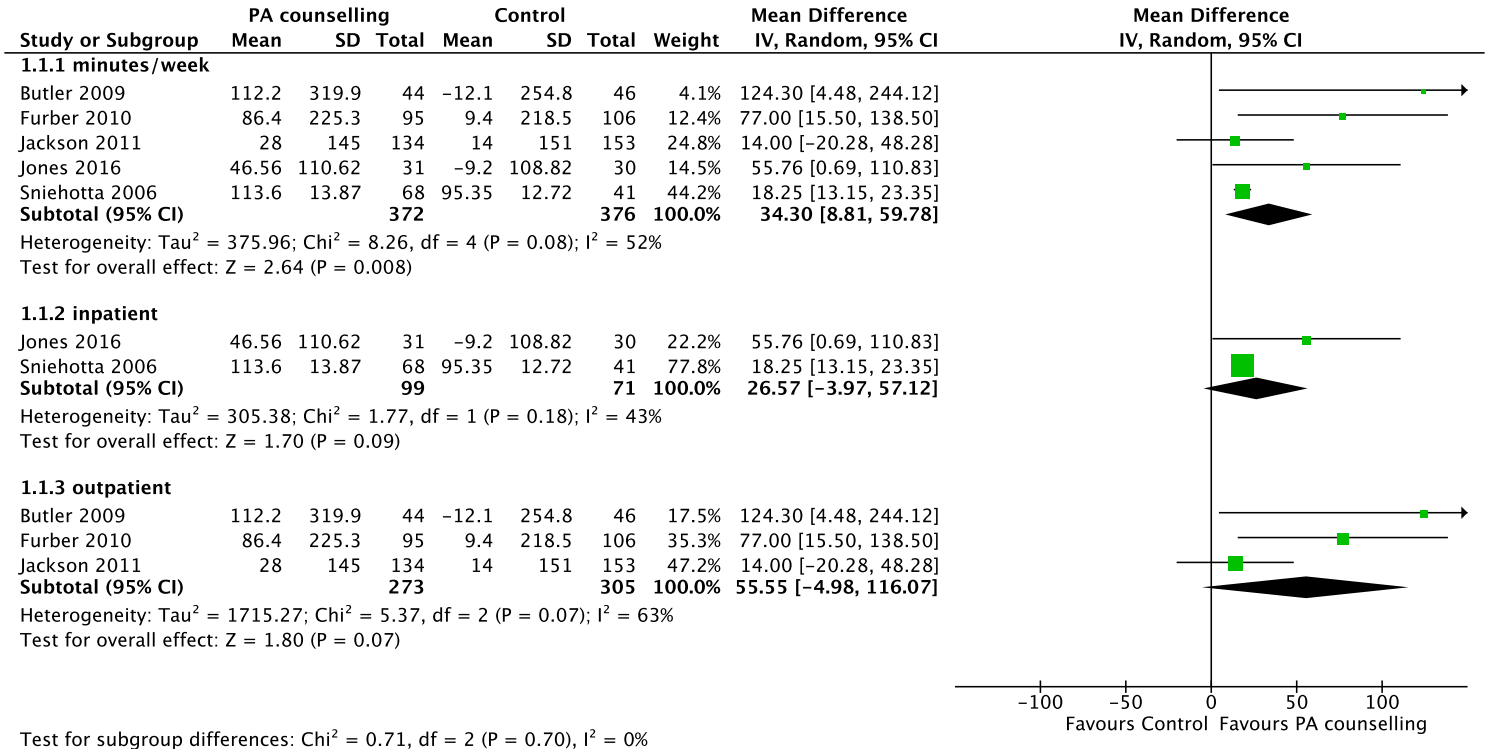

Figure 2.3 Physical activity minute per week Forest plot

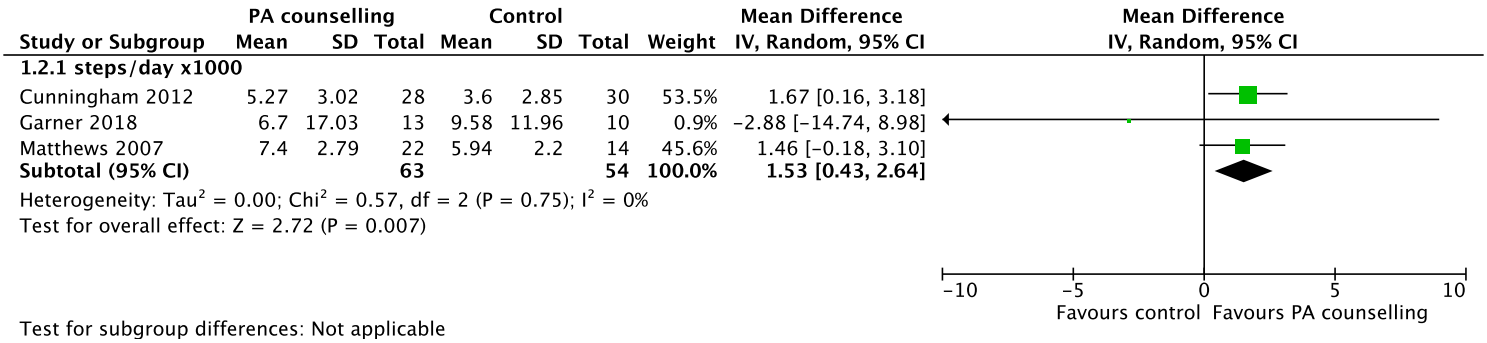

Figure 2.4 Steps Per Day x 1000 Forest plot

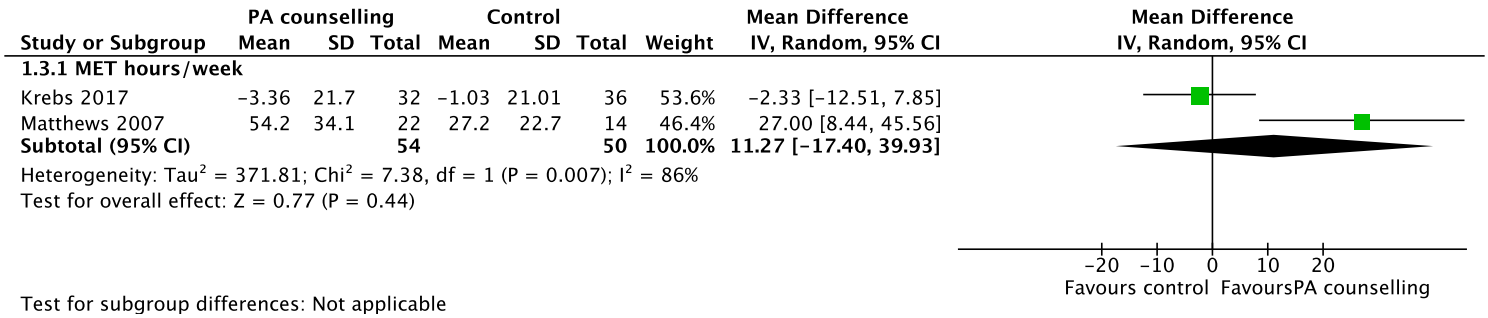

Figure 2.5 MET hours week Forest plot

Table 2.1 Summary of studies included in the systematic review.

Study	Setting	Participants	Intervention	Comparison	Outcome measures	Time to follow-up
Baruth 2015 [22]	Recruited from an outpatient cancer centre	n=32 participants (intervention 20, control 12). All women, early-stage breast cancer survivors. Mean age= 56 years. Baseline PA: 6.0 MET hrs/week	1x 30 min in-person counseling session, followed by 5x 10-15 min telephone counseling calls, over 12 weeks. The counseling aimed to increase walking, making use of education and behaviour change principles.	Usual care control group.	*Physical activity:* Community Health Activities Model Program for Seniors (CHAMPS) questionnaire. *Quality of life:* The Medical Outcomes 36-item Short Form Health Survey (SF-36). The International Breast Cancer Study Group (IBCSG) QOL Core Questionnaire. *Fatigue:* FACT-Fatigue	12 weeks
Brown 2014 [23]	Recruited from an alcohol and drug day treatment program and the community	n= 49 participants (brief advice group 23, aerobic exercise group 26). Including 22 females, 27 males. Mean age= 44 years.	1x 15-20 min in-person counseling session. Discussion of the psychological and physical benefits of exercise, education regarding frequency, duration and intensity recommendations.	Group moderate intensity aerobic exercise, group behavioural treatment, plus a financial incentive system.	*Alcohol dependence* *Alcohol use* *Depressive symptoms* *Anxiety symptoms* *Self-efficacy for alcohol abstinence* *Levels of exercise:* TLFB physical activity screen *Physical fitness:*	6 months

Study	Setting	Participants	Intervention	Comparison	Outcome measures	Time to follow-up
					Cardiorespiratory fitness test	
Butler 2009 [32]	Recruited from a cardiac rehabilitation program	n= 110 participants (brief intervention group 55, control group 55). Including 83 males, 27 females. Mean age= 64 years.	2x 15 minute telephone calls, week 1 and 3, shorter calls at week 12 & 18. Phone calls focused on behavioural counselling, goal setting & outcome expectancies. Pedometer, step calendar and walking safety sheet also provided.	Control group, given generic PA information brochure.	*Physical activity* Active Australia Survey *Submaximal cardiorespiratory fitness* *Self-efficacy for exercise* Self-efficacy for exercise Scale *Outcome expectancies* *Behavioural and cognitive self-management use* *Psychological distress*	6 months
Caswell 2009 [36]	Recruited from an outpatient colorectal screening	n=74 participants (intervention 41, control 33) Including 52 males, 22 females. Mean age= 62.4 years.	1x 2 hour in-person counseling session, followed with 3 personalized mailings, over 12 weeks. The session included assessments, general cancer prevention diet and activity education, a personalised program and discussion of social supports.	Usual care control group.	*Physical activity:* 7-day physical activity recall (Scottish physical activity questionnaire-2) *Fruit and vegetable intake*	12 weeks

Study	Setting	Participants	Intervention	Comparison	Outcome measures	Time to follow-up
Clark 2004 [37]	Recruited from an outpatient diabetes centre	n= 100 participants (*intervention and control group numbers not available). Including 58 men, 42 women. Mean age= 59.5 years. Participants had diabetes approximately 8 years and typically had one or more chronic illnesses.	1x 30 min in-person counseling session, followed by 3 x10min telephone calls at 1, 3 and 7 weeks following the intervention, then further in-person counseling at 12 and 24 weeks. The counseling session aimed to develop personalised dietary and physical activity self-management programs, including goal setting and overcoming barriers.	Usual care control group.	*Physical activity:* The Physical Activity Scale for the Elderly Questionnaire (PASE) *Diabetes self-management* *Dietary fat intake* *Fat-related dietary habits* *Weight, BMI (Body Mass Index), waist* *Blood markers: total serum cholesterol, total HDL-C, LDL-C, triglycerides, HbA1c*	12 months
Collins 2009 [24]	Recruited from a non-invasive vascular laboratory prior to discharge to the community	n=44 participants with peripheral arterial disease (intervention 18, control 26) Including 26 men, 18 women. Mean age 67.4 years.	1x 15-20 min in-person counseling session. Counseling involved education regarding peripheral arterial disease (PAD), the role of walking for exercise to manage PAD, overcoming barriers and an exercise prescription.	Video-watching comparison/control group. Video content: overview of PAD.	*Physical activity:* Part B of the NHIS WIQ (walking impairment questionnaire) *Leg symptoms*	12 weeks
Cunningham 2012	Recruited from a single acute health	n= 58 participants with intermittent claudication (IC) (intervention 28, control 30).	2x 1 hour, home-based in-person counseling sessions. Sessions included; education about IC, walking and health,	Usual care control group.	*Physical activity:* Daily step by pedometer. *Quality of life:*	4 months

Study	Setting	Participants	Intervention	Comparison	Outcome measures	Time to follow-up
[39]	board (in Scotland).	Including 39 men, 19 women. Mean age 65.3 years.	an individualised walking program, discussion of barriers and strategies to overcome.		Disease specific: Intermittent Claudication Questionnaire. General: WHOQOL-BREF *Perception of pain free walking distance.* *Acceptability of the intervention.*	
Cunningham 2013 [38]	Recruited from a single acute health board (in Scotland).	n= 58 participants with intermittent claudication (IC) (intervention 28, control 30). Including 39 men, 19 women. Mean age 65.3 years.	2x 1 hour home-based in-person counseling sessions. Sessions included; education about IC, walking and health, an individualised walking program, discussion of barriers and strategies to overcome.	Usual care control group.	*Physical activity:* Daily step by pedometer. *Quality of life:* Disease specific: Intermittent Claudication Questionnaire. General: WHOQOL-BREF *Perception of pain free walking distance.* *Acceptability of the intervention.*	2 years
Freene 2019	Recruited from an outpatient physiotherapy clinic	n= 40 participants (intervention 20, control 20). Including 33 women, 7 men. Mean age 44 years.	1x very brief face to face consultation (<5min), including provision of a brochure and brief discussion of PA guidelines. 4 physiotherapist lead PA	The second group received the same very brief intervention with only two measurement	*Physical activity:* ActiGraph activity monitor Active Australia Survey *Functional aerobic capacity:* STEP tool	18 weeks

Study	Setting	Participants	Intervention	Comparison	Outcome measures	Time to follow-up
[34]			measurements, baseline, week 6, 12 & 18.	sessions, baseline and 18 weeks.	*Quality of life:* AQoL-6D	
Furber 2010 [30]	Recruited from cardiac rehab non-attendees.	n= 215 participants (intervention 104, control 111). Including 151 men, 64 women. Mean age 66 years.	4x 15min telephone counseling sessions at weeks 1,3,12 and 18, plus mail-based follow up. Phone calls focused on increasing self-efficacy, increasing outcome expectancies, establishing physical activity goals and behavioural reinforcement.	Usual care control group.	*Physical activity:* Active Australia Questionnaire. *Self-efficacy for exercise scale* *Outcome expectation for participation in Physical Activity* *Self-management strategy use* *Psychological distress*	6 months
Garner 2018 [44]	Recruited from an early inflammatory arthritis clinic	n=28 participants with a new diagnosis of rheumatoid arthritis (intervention 14, control 14). Including 5 men, 23 women) Mean age 47 years.	1x 2 hour in-person first counseling session, followed by a 90min second session. Treatment targeted both dietary and physical activity advice.	Usual care control group.	*Physical Activity:* Pedometer step count. *Quality of life:* Health Assessment Questionnaire (HAQ). Physician / patient global evaluation score (VAS 0-100) *Nutritional intake* *Tender & swollen joint counts*	6 months

Study	Setting	Participants	Intervention	Comparison	Outcome measures	Time to follow-up
Green 2022 [35]	Recruited from an outpatient rehabilitation program.	n=35 participants (intervention 18, control 17). Including 16 men, 19 women. Mean age 71 years.	1x 15-45 minute face to face, stage of change based, PA education and counselling session. Treatment addressed goal setting, problem solving & social support for behaviour change.	Control group, given generic PA information brochure.	*Physical activity:* GENEActiv™ armband activity monitor. *Feasibility* *Quality of life:* AQoL-5D *Stage of change for exercise:* Exercise Stage Assessment Questionnaire *Self-efficacy for exercise:* The self-efficacy for exercise scale	3 months
Jackson 2011 [25]	Recruited from prenatal care practices	n= 321 pregnant women (intervention 158, control 163). Mean age 26.5 years.	1x 10-15min interactive Video Doctor teaching and counseling session, about nutrition, exercise, and weight gain.	Usual care control group.	*Physical activity:* Self-reported Min/week of PA *Dietary:* *Servings per day fruit & vegetable* *Food knowledge, knowledge of guidelines, weight gain.*	6 weeks
Jones 2016	Recruited from an inpatient coronary care	n=70 participants (intervention 35, control 35).	1x 15 min animated psycho-educational intervention delivered on an iPad. The intervention focused on the	Usual care control group.	*Physical activity:* subjective min per week *Adherence*	7 weeks

Study	Setting	Participants	Intervention	Comparison	Outcome measures	Time to follow-up
[46]	unit prior to discharge to the community	Including 49 men and 21 women). Mean age 61 years.	pathogenesis of acute coronary syndrome and informing participants about behaviours to maintain their health.		*Illness perceptions* *Medication Beliefs* *Cardiac anxiety* *Satisfaction with intervention* *Patient drawings of the heart*	
Krebs 2017 [26]	Recruited from an outpatient cancer centre.	n= 86 patients who had completed their treatment for either breast or prostate cancer (intervention 44, control 42). Including 4 males, 82 females. Mean age 59.8 years.	1x 60 min e-health program provided via DVD. The program focused on education and behaviour change counseling, to meet Physical activity guidelines and reduce sedentary time.	Usual care control group (which included in-person brief advice & counseling).	*Physical activity:* Godin Leisure-Time Exercise Questionnaire *Fruit and vegetable intake* *Acceptability and feasibility of the intervention (qualitative feedback)*	12 weeks
Matthews 2007 [27]	Recruited from an outpatient cancer clinic.	n=36 breast cancer survivors (intervention 22, control 14). Including women only. Mean age 53.5 years.	1x 30 min in home counseling session, plus 5 x 10-15 min follow up telephone calls over 12 weeks. Behavioural counseling focused on goal setting, physical activity safety, motivators, barriers and social support.	Usual care control group.	*Physical activity:* Self-report logs, pedometer steps, RPE, CHAMPS, Actigraph activity monitor *Body weight and composition* *Dietary patterns*	12 weeks

Study	Setting	Participants	Intervention	Comparison	Outcome measures	Time to follow-up
Osborn 2010 [28]	Recruited from an outpatient, primary care clinic.	n=91 type two diabetics (intervention 48, control 43). Including 23 men, 68 women. Mean age 57.6 years.	1x 90min in-person counseling session. The session focused on education, motivation and behaviour change, in relation to diet, health management and physical activity.	Usual care control group.	• Physical activity: exercise subscale of SDSCA (diabetes specific outcome) *Food label reading* *Diet adherence* *Glycaemic control*	12 weeks
Redfern 2008 [33]	Recruited from coronary care in a tertiary referral hospital.	n= 144 acute coronary syndrome survivors (intervention 72, control 72). Including 107 men, 37 women. Mean age 64.5 years.	1 x 60min initial consultation followed by 3x phone calls over three months. Risk factor screening, goal setting, education regarding management options. Including lowering cholesterol, blood pressure, increasing PA & smoking cessation.	Usual care control group.	*Physical activity:* 7 day International PA Recall Questionnaire *Quality of life:* Short form 36 *Prevalence of coronary risk factors* *Depressed mood* *Participant's knowledge of own risk factors* *Medical consultation frequency*	12 months
Sangster 2015 [47]	Recruited from an outpatient cardiac rehabilitation program.	n= 313 participants (intervention 157, control 156). Mean age 64.2 years.	Intervention #1 4x 15min telephone counseling sessions, plus mail-based follow up. Phone calls focused on increasing self-efficacy,	Intervention #2 'Healthy weight intervention' 6x brief telephone counseling sessions, plus mail based follow	*Physical activity:* Self-reported PA *Self-reported sedentary time* *Self-reported weight & BMI*	6-8 months

Study	Setting	Participants	Intervention	Comparison	Outcome measures	Time to follow-up
			increasing outcome expectancies, establishing physical activity goals and behavioural reinforcement.	up. Phone calls focused on optimizing BMI via dietary and physical activity advice.		
Scholz 2006 [40]	Recruited from an inpatient cardiac rehabilitation unit prior to discharge to the community	n= 198 participants with coronary heart disease (intervention 103, control 95). Including 163 men, 35 women. Mean age 58.5years.	1x 15 min in-person 'individual planning session', to develop written action plans and coping plans in relation to exercise. Weekly mail out diaries for 6 weeks.	Usual care control group.	*Physical activity:* IPAQ *Depressive symptoms* *Intentions* *Goal attainment* *Health status* *BMI*	12 months
Sniehotta 2005 [42]	Recruited from three inpatient cardiac rehabilitation centres prior to discharge.	n=240 participants (unclear how many participants in each group). Including 195 men, 45 women. Mean age 58 years.	Intervention #1 Planning group; one face to face planning session, completed worksheet for action plans and coping plans. Intervention #2 Planning plus diary group; as above, plus completion of a weekly diary for 6 weeks after discharge.	Usual care control group.	*Physical activity:* Kaiser Physical Activity Survey *Self-efficacy for exercise:* *Self-efficacy for Exercise Scale* *Planning* *Action control*	4 months

Study	Setting	Participants	Intervention	Comparison	Outcome measures	Time to follow-up
Sniehotta 2006 [41]	Recruited from an inpatient cardiac rehabilitation unit prior to discharge to the community	n=246 participants with coronary heart disease (intervention #1 81, intervention #2 71, control 94). Including 165 men, 46 women. Mean age 59.3 years.	Intervention #1 1x 30 min in-person 'individual planning session', to develop written action plans in relation to exercise. Intervention #2 1x 30 min in-person 'individual planning session', to develop written action plans and coping plans in relation to exercise.	Usual care control group + alternate intervention group	*Physical activity:* Self-reported PA Cycling instead of car or public transport use *Self-efficacy for PA* *Risk perceptions* *Outcome expectancies* *Behavioural intentions*	2 months
Wolkanin- Bartnik 2011 [45]	Recruited from an outpatient cardiology clinic	n=115 over 60-year-old participants with stable coronary artery disease (intervention 59, control 56). Including 97 men, 18 women. Mean age 67.5 years.	1x in-person counseling session, including education about recommendations and parameters for safe exercise. An exercise guidebook was provided, and participants were offered a doctor phone call to discuss any concerns.	Usual care control group.	*Physical activity:* Self-reported PA: modified Global PAQ. *Adherence/ compliance* *Presence of atherosclerosis risk factors* *Incidence of cardiovascular events*	12months
Vickers 2011	Recruited from an outpatient Cardiovascular Health clinic	n= 509 cardiovascular health clinic attendees (intervention 217, control 292). Including 351 men, 158 women. Mean age 61.2 years.	Participants were asked to watch a 43 min DVD which provided education and behaviour change strategies,	Usual care control group.	*Physical activity:* IPAQ *Self-efficacy for exercise* *SOC for exercise*	6 weeks

Study	Setting	Participants	Intervention	Comparison	Outcome measures	Time to follow-up
[29]			to initiate and maintain regular physical activity.		*Behavioural change* *Outcome expectations for exercise* *Usage and opinions of DVD*	
Ziegelmann 2005 [43]	Recruited from outpatient orthopaedic rehabilitation.	n= 373 participants with musculoskeletal and orthopaedic diseases and injuries (intervention 186, self-administered control 187). Including 140 men, 233 women. Mean age 45.7 years.	Interviewer-assisted planning: 10 minute face to face assistance to complete an action planning sheet, interviewer used motivational interviewing skills & empathic listening.	Self-administered planning: Participants self-completed the same planning sheet as intervention group. Experimenter was present however repeated basic instructions only.	*Physical activity:* Duration, intensity and frequency/week *Self-efficacy* *Subjective physical health*	6 months

What is the effect of a brief intervention to promote physical activity when delivered in a healthcare setting? A systematic review.

Green, E T., Cox, N S., Warren, C J., Arden, C M., Holland, A E.

Table S1. Search strategy

	Search engine terms- Medline	**Search engine terms- Embase**	**Search engine terms- CINAHL**	**Search engine terms- PSYCHINFO**
INTERVENTION- part 1 Physical activity Exercise Walking	Exercise/ or exercis* Walking/ or walking Physical fitness/ or fitness Physical endurance/ or endurance Motor activity/ or motor activit* physical activit*	Exercise/ or exercis* Walking/ or walking Fitness/ or fitness Endurance/ or endurance Motor activity/ or motor activit* Physical activity/ or physical activit*	Exercise/ or exercis* Walking/ or walking Physical fitness/ or fitness Physical endurance/ or endurance Motor activity/ or motor activit* Physical activity/ or physical activit*	Exercise/ or exercis* Walking/ or walking Physical fitness/ or fitness Physical endurance/ or endurance Motor activit* Physical activity/ or physical activit*
INTERVENTION- part 3 Brief intervention	((brief or minimal) adj3 intervention*) ((brief or minimal) adj3 physical adj3 intervention*)	((brief or minimal) adj3 intervention*) ((brief or minimal) adj3 physical adj3 intervention*)	((brief or minimal) n3 intervention*) ((brief or minimal) n3 physical n3 intervention*)	((brief or minimal) adj3 intervention*) ((brief or minimal) adj3 physical adj3 intervention*)
Language	English	English	English	English
N=	770	1,012	499	413

Total= 2,694. All keywords searched as: (keyword). ti,ab.

Chapter 3: Feasibility study

Declaration for thesis Chapter Three, which was published in Journal of Aging and Physical Activity, 2021:

Green ET, Cox NS, Holland AE. A Brief Intervention of Physical Activity Education and Counseling in Community Rehabilitation: A Feasibility Randomized Controlled Trial. Journal of Aging & Physical Activity. 2021:1-8. PubMed PMID: 34853185.

The nature and extent of my contribution to the work in Chapter Three was the following:

Nature of contribution	**Extent of contribution**
Principle author responsible for the concept, design, study management, statistical analysis, manuscript development and writing.	80%

The following co-authors contributed to the work. There are no student co- authors.

Name	**Nature of contribution**
Narelle S Cox	Assisted with concept, design, statistical analysis, manuscript development and writing.
Anne E Holland	Assisted with concept, design, statistical analysis, manuscript development and writing.

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the candidate's and co-authors' contributions to this work.

Candidate's Signature: Emily Green Date: 15/02/2022

Main Supervisor's Signature: Anne Holland Date: 16/02/2022

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Human Kinetics
ORIGINAL RESEARCH

A Brief Intervention of Physical Activity Education and Counseling in Community Rehabilitation: A Feasibility Randomized Controlled Trial

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This study aimed to assess the feasibility of delivering a brief physical activity (PA) intervention to community rehabilitation clients. Participants were randomized to receive one session of stage-of-change-based PA education and counseling in addition to written educational material, or education material alone. Outcomes were measured at baseline and 3 months; the primary outcome was feasibility, measured by the percentage of those who were eligible, consented, randomized, and followed-up. A total of 123 individuals were both eligible and interested in participating, 32% of those screened on admission to the program. Forty participants consented, and 35 were randomized, with mean age 72 years ($SD = 12.2$). At baseline, 66% had recently commenced or intended to begin regular PA in the next 6 months. A total of 30 participants were followed-up. It is feasible to deliver education and counseling designed to support the long-term adoption of regular PA to community rehabilitation clients. Further refinement of the protocol is warranted (ACTRN12617000519358).

Keywords: exercise, walking, health behavior, adults, health care

Physical inactivity has been described as "the biggest public health problem of the 21st century" (Blair, 2009). Physical inactivity accounts for around 9% of premature mortality, and eliminating physical inactivity could increase life expectancy and reduce the incidence of coronary heart disease, Type 2 diabetes, and breast and colon cancers by up to 10% (Lee et al., 2012). Australian physical activity (PA) guidelines (The Department of Health, 2019) recommend all adults aim to accumulate a minimum of 150 min of moderate intensity, or 75 min of vigorous intensity, PA per week. Yet more than half of Australian adults do not meet these guidelines, and for those aged 75 years and over, up to three quarters are not sufficiently active (Australian Institute of Health and Welfare, 2020).

The health care system is an important vehicle for promoting PA, particularly for older people and those with chronic health conditions (Smith & Milton, 2019). In Australia, community rehabilitation programs provide outpatient, goal-oriented, and multidisciplinary rehabilitation to community-dwelling adults. Clients are typically referred following a change in health status, such as stroke, joint replacement, fall, or general deconditioning. Many also suffer from a range of chronic health conditions. Clinicians in community rehabilitation are ideally placed to promote the benefits of PA to clients at high risk of physical inactivity. In other rehabilitation settings, including cardiac and pulmonary rehabilitation, education, written information, PA counseling, and coaching have all been demonstrated to increase adoption of PA (Caswell et al., 2009; Ghisi et al., 2014; Mantoani et al., 2016). However, as yet, no studies have investigated whether interventions aimed to increase levels of PA are effective in people attending community rehabilitation with a variety of chronic medical issues.

Brief interventions or "brief advice" are defined by the National Institute for Health and Care Excellence guidelines (National Institute for Health & Care Excellence, 2013) as "verbal advice, discussion, negotiation or encouragement, with or without written or other support or follow up. This may vary from basic advice to a more extended individually focused discussion." Brief interventions are typically delivered individually, face-to-face, and range from a single session of short duration (5–30 min) to multiple brief sessions (Gc et al., 2016). Brief interventions are effective in increasing PA levels when delivered by physicians in primary care (Eakin et al., 2000; Marcus et al., 2006) and have the advantage of being affordable and easy to deliver (Gc et al., 2016). Brief interventions may also make use of health behavior change models (Marcus et al., 2006). Theory-based behavioral interventions have been demonstrated to increase PA 10%–15% more than usual care (Biddle et al., 2012). Use of such models to develop "Individually Adapted Health Behaviour Change Programs" has been demonstrated to increase frequency of PA, time spent in PA, and energy expenditure in healthy adults (Kahn et al., 2002). Such programs are tailored to the individual's readiness for change and teach participants specific behavioral skills that enable the participant to integrate moderate-intensity PA into their daily routine (Kahn et al., 2002). Whether a brief intervention, encompassing behavior change theory, can be delivered to adults with chronic illness attending community rehabilitation is unclear.

This study aimed to assess the feasibility of delivering a brief intervention of PA education and counseling to community rehabilitation clients, and to provide preliminary information on the effect of a brief intervention of PA education and counseling on PA participation of clients attending a community rehabilitation program.

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Method

Recruitment

This study took place in an outpatient community rehabilitation program in Melbourne, Australia. Clients attending community rehabilitation participate in a multidisciplinary outpatient program, often including physiotherapy, for goal-oriented rehabilitation. Duration of attendance is typically around 8 weeks, intensity of therapy depends on the client's needs and goals. Physiotherapists in this setting encourage the adoption of long-term PA through brief discussion during sessions and offer referral to ongoing exercise classes. No formal education or counseling is given around the benefits of or recommendations for PA.

Eligible participants were adults aged 18 years and older, attending the center-based community rehabilitation service, who could read and speak English, and were able to provide informed consent. Potential participants were excluded if they were non-ambulant, had medical or safety issues preventing them from safely participating in regular PA, had cognitive impairment (Mini-Mental State Exam < 24 or diagnosis of dementia), or were receiving a home-based rehabilitation service.

Eligibility and interest in participation were screened on admission to the program, while consent and baseline measures were collected on client discharge; therefore, not all clients who expressed interest in participating were recruited to the study. Rather, the first 40 participants to reach discharge and provide consent were recruited.

Study approval was obtained from Alfred Health and La Trobe University ethics committees. Written informed consent was obtained from all participants. This trial was registered with Australia and New Zealand Clinical Trials Registry (ID: ACTRN12617000519358).

Design

Participants were randomly allocated to a control or intervention group, using a computer-generated sequence. Randomization was stratified by age (≤64 vs. >64 years) and completed by a researcher independent of the trial. Allocation was concealed using opaque envelopes. Randomization occurred after completion of the baseline assessment.

Blinding

The participant's treating therapy team advised the research team whether the participant met the inclusion/exclusion criteria; however, treating therapists were not involved in other aspects of the research. The assessment and intervention were delivered on discharge from the community rehabilitation program. A researcher blinded to group allocation completed all follow-up measures.

Procedure

Baseline Assessment

Demographic information was collected from the participant's medical record on recruitment to the study. Following the participant's final physiotherapy rehabilitation appointment, a member of the research team completed baseline measures and fitted the activity monitor. Participants returned to the center 1 week later to return the activity monitor and receive either the intervention or control condition.

Intervention Conditions

Participants in the intervention group received one additional session to their usual rehabilitation regimen. One physiotherapist delivered all brief interventions, which included education about the benefits and recommendations for PA and tailored PA advice based on the participant's stage of change. No specific training was undertaken prior to intervention delivery; the physiotherapist had 5 years of experience working with clients in this setting. The intervention was between 15 and 45 min in duration. The PA education included provision of an Australian Government Department of Health PA educational booklet and discussion of its contents. Adults (18–64 years) received the *Make your move—Sit less—Be active for life!* (Australian Government, 2014) brochure; older adults (aged 65 years and older) received *Choose Health: Be Active—A physical activity guide for older Australians* (Australian Government, 2005).

Stage-based PA counseling included the key components outlined for Individually Adapted Health Behaviour Change Programs (Kahn et al., 2002), including: setting goals for PA and self-monitoring, building social support for new behavioral patterns, behavioral reinforcement through self-reward and positive self-talk, problem solving geared toward maintenance of behavior change, and prevention of relapse into sedentary behaviors. The intervention was tailored to the participant's stage of change in relation to exercise (see Supplementary Material [available online] for intervention protocol) (Burbank et al., 2002). Participants in the intervention group were also offered a written walking program. The walking program was graded based on current level of PA and aimed to progress activity so that participants met or exceeded the national PA Guidelines of a minimum of 30 min of moderate paced walking per day.

Control Condition

Control group participants were given a copy of the written educational material, as outlined above. No PA counseling was provided to these participants.

Follow-Up

Participants were assessed 3 months after delivery of the intervention to reassess PA participation and other secondary outcome measures. Participants were asked to return to the center 1-week following the assessment to return the activity monitor and complete an interview.

Outcomes

The primary outcome was feasibility, defined as number of participants who were eligible, interested, consented, in each stage of change, completed the intervention, and were followed up at 3 months. Interest in receiving the intervention was indicated by checking a box on a return slip in response to an advertising flyer for the project. Acceptability of the intervention was assessed via interview following the 3-month follow-up assessment (Table 1). Interviews were conducted by a researcher independent of the participant's treating team, and not involved in intervention delivery. The interviews were audio recorded and transcribed verbatim.

Secondary outcomes were objectively measured PA levels, quality of life, stage of change, and self-efficacy. Physical activity participation was assessed using the GENEActiv™ activity monitor (GeneActiv™; ActivInsights Ltd., Kimbolton, Cambridgeshire, United Kingdom). The GENEActiv™ is a valid and reliable

Table 1 Participant Feedback Interview Questions

1. What do you remember about: (intervention group) – the extra therapy session where you discussed PA? (control group) – the PA information book you were given?
2. How easy to understand was this information?
3. How useful was this information to you?
4. What in particular did you find to be useful?
5. Which aspects did you not find useful?
6. Could you tell me about any ways in which the information affected your PA habits?
7. What was most difficult about participating in a walking program?
8. Did you notice any benefits from participating in a walking program?
9. Would you recommend this program to a friend in a similar situation as yourself?

Note. PA = physical activity.

measurement tool for the classification of PA intensity in adults (Esliger et al., 2011; Zhang et al., 2012). Participants wore a GeneActiv™ for 7 days (Dillon et al., 2016) on their preferred wrist. The rate of energy expended during exercise was quantified in metabolic equivalents (MET). Intensity of PA was categorized using the following MET classifications: sedentary, <1.5 MET; light, 1.5–2.99 MET; moderate, 3–5.99 MET; and high, ≥6.0 MET (U.S. Department of Health and Human Services, 1996).

Quality of life was measured using the Assessment of Quality of Life instrument (Allen et al., 2013). This 20-item tool encompasses the domains of independent living, mental health, coping, relationships, pain, and senses. Stage of change was assessed by the Exercise Stage Assessment questionnaire (Burbank et al., 2002). This scale asks participants to rate their intention to engage in regular exercise by selecting the statement which best reflects their current intention or behavior, allowing the researcher to identify which stage of change, in relation to exercise, the participant is in. Self-efficacy was measured using the Self-Efficacy for Exercise Scale. Self-efficacy is one of the most consistent predictors of exercise adherence (Jones et al., 2005). The Self-Efficacy for Exercise Scale asks participants to rate their confidence to exercise under 11 different conditions on a 10-point scale. The Self-Efficacy for Exercise Scale has been validated for use in older adults (Resnick & Jenkins, 2000).

Analyses

Feasibility data and stage of change level were reported descriptively. Other data were analyzed using IBM® SPSS® Statistics (version 25.0; IBM Corp., Armonk, NY). Paired and independent t tests, Wilcoxon signed rank test, or Mann–Whitney U test was applied to assess within-group and between-group differences in PA levels, quality of life scores, and self-efficacy toward exercise, depending on distribution of data. Missing data were excluded analysis by analysis. Results were considered significant at $p < .05$. Qualitative interviews were coded by two independent reviewers, and thematic analysis was conducted with consensus achieved by discussion.

Results

Participants

The mean age of participants was 72 (range = 34–90, $SD = 12.2$) years, and 54% were female. The primary reasons for referral to the service were orthopedic (43%), falls (40%), and stroke (23%), with 14 participants being referred for more than one presenting issue. Nearly all participants had one or more chronic diseases other than their referral diagnosis, with the most common being cardiac conditions (55%), arthritis (30%), back pain (28%), and diabetes (25%). Table 2 shows the demographic characteristics of participants at baseline.

Feasibility

Of 382 clients admitted and discharged from community rehabilitation during the study period, $n = 243$ (64%) were confirmed eligible, $n = 113$ (29%) were confirmed not eligible, and we were unable to confirm eligibility for the remaining, $n = 26$ (7%) (Figure 1). The primary reasons for those not eligible ($n = 113$) were cognitive impairment, $n = 32$ (28%); speaking a language other than English, $n = 29$ (26%); not safe to mobilize outdoors, $n = 21$ (19%); or medically unfit to participate as determined by their treating therapist, $n = 18$ (16%).

Of potentially eligible clients, 123 (32%) were interested and agreeable to be contacted by the treating team to discuss the project further; 25 (7%) clients did not respond; and 95 (24%) declined further contact by the research team, primarily being "not interested" $n = 35$ (37%) and "too busy" $n = 28$ (29%). Other reasons for declining involvement in the study included limited rehabilitation attendance (8%), being medically unwell (6%), and not available following rehabilitation to participate in study (5%).

Of the 40 participants who provided written consent to participate, 35 went on to complete baseline measures and receive the control or intervention conditions. The reasons for drop out were becoming medically unwell ($n = 2$), moving from the area ($n = 1$), losing interest in the study ($n = 1$), and one participant felt dizzy when wearing the activity monitor.

Those who were randomized reported their stage of change in relation to PA to be 14% ($n = 5$) contemplation, 23% ($n = 8$) preparation, 29% ($n = 10$) action, and 34% ($n = 12$) maintenance stage. All 35 participants received the allocated intervention as intended. At 3-month follow-up, 30 of the 35 participants completed the outcome measures. Reasons for loss to follow-up were unable to be contacted ($n = 2$), unavailable for data collection due to travel ($n = 2$), and one participant had moved into residential care and ceased driving.

Acceptability of the intervention was assessed via interview, with six key themes emerging. *Raised awareness of the importance*

Table 2 Baseline Participant Characteristics in the Study Population

	Control group ($n = 17$)	Intervention group ($n = 18$)
Age (years)[a]	71.2 (12.5)	71.6 (11.6)
<65	$n = 12$	$n = 12$
Sex ratio M:F	8:9	8:10
Referral diagnosis		
Orthopedic	9 (36)	5 (20.8)
Falls	3 (12)	9 (37.5)
Stroke	3 (12)	4 (16.7)
Arthritis	4 (16)	2 (8.3)
Neuro	3 (12)	3 (12.5)
Vestibular	1 (4)	1 (4.2)
Heart/lung	1 (4)	0 (0)
Cancer	1 (4)	0 (0)
Other	0 (0)	0 (0)
Diabetes	0 (0)	0 (0)
Comorbidities		
Arthritis	5 (10)	5 (9)
Osteoporosis	3 (6)	1 (2)
Back pain	5 (10)	5 (9)
Heart	8 (16)	10 (19)
Lung	5 (10)	1 (2)
Cancer	1 (2)	4 (7)
Depression/anxiety	4 (8)	3 (6)
Diabetes	4 (8)	4 (7)
Stroke	1 (2)	2 (4)
Other neurological	3 (6)	5 (9)
Other	10 (20)	14 (26)
None	1 (2)	0 (0)
BMI (kg/m^2)[a]	26.5 (5.9)	27.8 (5.4)[b]
Exercise Stage Assessment questionnaire		
Precontemplation	0 (0)	0 (0)
Contemplation	3 (18)	2 (11)
Preparation	5 (29)	3 (17)
Action	4 (24)	6 (33)
Maintenance	5 (29)	7 (38)
Self-Efficacy for Exercise Scale[a]	80.2 (20.9)	77.9 (19.5)
AQoL-6D[a]	41.4 (11.4)	41.1 (11)
PA[a]		
Sedentary (average min/day)	1,293 (134)	1,289 (148)
Light activity (average min/day)	330 (84)	302 (98)
Moderate–vigorous activity (average min/day)	80 (61)	94 (81.4)
Number of bouts of MVPA (average/day)	0.75 (0.85)	1.03 (1.3)
Length of bouts of MVPA (average min/bout)	9.9 (6.1)	10.8 (6.6)

Note. Values are presented as *n* (%) unless otherwise indicated. MVPA = moderate–vigorous PA; PA = physical activity; AQoL = Assessment of Quality of Life instrument; bouts, >10 min continuous PA.
[a]Values are presented as mean (*SD*). [b]Data not available for one participant.

of regular PA: participants reported that PA education and counseling raised their awareness of the importance of regular PA and motivated them to keep active: "I had been going to rehab physio and had got out of the habit of doing regular exercise, so it was a good reinforcement to get me to get into regular exercise again."

Reinforced existing knowledge: In many cases, the information provided in these sessions was not new; however, provided a good reminder and reinforced existing knowledge: "You know we've all heard the message before, but it doesn't hurt at all for a reminder, which I think that was." *Poor recall:* The information booklet alone

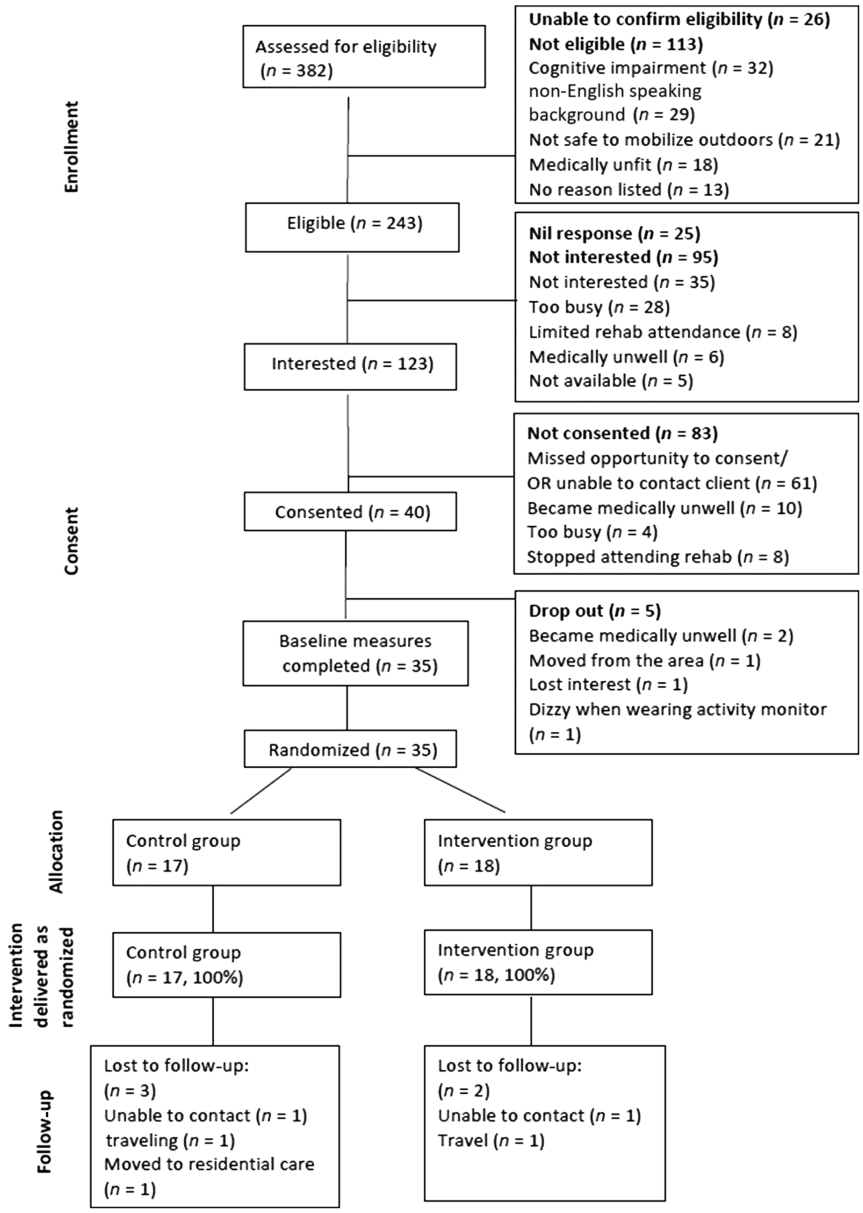

Figure 1 — Consort diagram for the trial ITT. ITT = intention to treat.

Table 3 Within- and Between-Group Change in Outcome Measures From Baseline to Follow-Up

	Control group	Intervention group	Between group	
Outcome	**Change from baseline**	**Change from baseline**	**Difference between groups**	***p***
AQoL-6D	–0.7 (5.4)	1.4 (5)	–2 (Martinez et al.)	.304
Self-Efficacy for Exercise Scale	6.8 (27)	–9.2 (32.2)	–2 (30.6)	.51
PA				
Sedentary (average min/day)	6 [–122, 87]	38 [–89, 89]	28.6 [–99.5, 88.5]	.7
Light activity (average min/day)	–14 [43, 34]	–39 [–97, 15]	–23.4 [–49, 23.2]	.316
MVPA (average min/day)	4.4 [–8.3, 19]	–11 [–48, 8]	–1.8 [–32, 11.5]	.072
Number of MVPA bouts (average/day)	0 [–0.3, 0.2]	–0.25 [0.9, 0]	–0.2 [–0.65, 0.05]	.093
Length of MVPA bouts (average/day)	1.4 [–1.2, 3]	–1 [3.2, 2.8]	0.4 [–2.5, 2.75]	.404

Note. All PA measures are expressed as median [IQR], other variables are expressed as mean (*SD*). AQOL-6D = Assessment of Quality of Life instrument; PA = physical activity; IQR = interquartile range; MVPA = moderate–vigorous PA.

Table 4 Stage of Change for PA

	Control group ($n = 14$)		Intervention group ($n = 16$)		Total population ($n = 30$)	
Exercise Stage Assessment questionnaire	**Baseline**	**Follow-up**	**Baseline**	**Follow-up**	**Baseline**	**Follow-up**
Precontemplation	0 (0)	0 (0)	0 (0)	3 (19)	0 (0)	3 (10)
Contemplation	2 (14)	0 (0)	2 (12)	1 (6)	4 (14)	1 (3)
Preparation	4 (29)	4 (29)	3 (19)	2 (12.5)	7 (23)	6 (20)
Action	3 (21)	2 (14)	4 (25)	5 (31.25)	7 (23)	7 (23)
Maintenance	5 (36)	8 (57)	7 (44)	5 (31.25)	12 (40)	13 (43)
Change in stage at follow-up						
Progressed		7 (50)		1 (6)		8 (26.6)
Maintained		6 (43)		8 (50)		14 (46.6)
Regressed		1 (7)		7 (44)		8 (26.6)

Note. Values are presented as *n* (%). Only participants who completed both baseline and follow-up measures are included in this data. PA = physical activity.

was poorly recalled by participants: "I'm having difficulty placing it actually because I have been given many bits of pamphlets and booklets to read." A number of participants also failed to recall any specific details of the PA education and counseling. *Walking helped participants to "feel better"*: Eight participants reported that regular walking helped them to "feel better" and increased their endurance: "It makes you feel a little bit tired, but then you feel better." *Minimal impact on participants who were already sufficiently active:* Participants who were already sufficiently active reported that the education and counseling program did not result in any change to their PA routine. *Key barriers to PA*: reported to be inclement weather, time, other commitments, and poor health.

Secondary Outcomes

Physical activity data were available for 34 participants at baseline and 30 participants at follow-up. The group as a whole undertook a mean (*SD*) of 87 (69) min of moderate–vigorous PA per day. There was no significant difference between groups for change in PA time over the course of the study (Table 3).

At 3-month follow-up, there was no difference between groups in the proportion of participants in active/maintenance stages versus other stages (control 71% vs. intervention 63%, $p = .60$). Half of the control group participants ($n = 7$; 50%) had progressed their stage of change for exercise, compared with only $n = 1$ (6%) of intervention group participants (Table 4). There was no difference between groups for change in Self-Efficacy for Exercise or Quality of Life (Table 3).

Discussion

We investigated the feasibility of delivering a brief intervention of PA education and counseling to community rehabilitation clients. The intention was to encourage clients completing their community rehabilitation program to maintain an active lifestyle, through the provision of additional education and counseling, including setting goals for PA, building social support, problem-solving skills, and behavioral reinforcement. We found that a brief PA intervention is feasible to deliver in this setting, with half of all eligible clients expressing interest in participation and good participant retention through the 3-month trial. Further research is required to establish the efficacy of this intervention.

From the community rehabilitation population screened, 64% were deemed eligible, with 51% of eligible clients (32% of the population screened) expressing interest in taking part in this type of education and counseling. The rate of interest was comparable with similar health care based, brief PA interventions. Research in a Type 2 diabetic population found 29% of patients screened were both eligible and interested in participation (Clark et al., 2004), and in a population screened to be at risk of colorectal cancer, 51% of eligible clients were recruited (Caswell et al., 2009). The outpatient rehabilitation population is at high risk of physical inactivity due to increased age and the presence of acute on chronic health problems (Smith & Milton, 2019), and thus the level of interest received in this intervention may provide clinicians with a valuable opportunity to influence PA behavior for a suitable and receptive audience. At baseline, 66% of participants reported either intending to start regular PA or had recently started regular PA within the last 6 months, indicating the relevance of a program that addresses the topic. All interventions were delivered as randomized, and retention of participants between baseline and follow-up was 86%, indicating acceptability of the program. A comparable study, investigating the feasibility of a program to increase PA post knee arthroplasty, cited 80% retention as a cutoff for determining feasibility (Paxton et al., 2018).

Our qualitative data support the use of education and counseling to raise awareness of the importance of PA, reinforce existing knowledge, and assist in problem solving to overcome barriers to PA. Provision of written material alone was poorly recalled and therefore does not appear to be sufficient to promote behavior change in this context. Poor participant recall of the specific details of the intervention may suggest that a single session is too brief to make a significant impact in this population. Furthermore, a lack of trend toward improved PA in the intervention group may suggest the need to optimize the intervention prior to further testing. While a number of studies have found single-session brief interventions to increase participant PA levels, when delivered in the health care setting (Jackson et al., 2011; Jones et al., 2016; Wolkanin-Bartnik et al., 2011), each of these have studied a single diagnosis population group with a younger mean age. It is possible that the varied diagnosis, presence of multiple other chronic health conditions, and older mean age group of the community rehabilitation population add additional complexity to achieving behavior change. Other

comparable studies investigating brief interventions in the health care setting have demonstrated success in increasing PA levels with the use of follow-up phone calls (Clark et al., 2004) and tailored mail outs (Caswell et al., 2009) as adjuncts to a brief face-to-face counseling session; again these studies examined disease specific populations. However, follow-up of this nature may assist in recall, problem solving for barriers to PA, and thus adherence to recommendations for the intervention population.

This feasibility study included a small number of participants and was not powered to detect change in the secondary outcome measures, so further work would be required to assess the clinical benefits of this strategy. The secondary outcomes provide preliminary data regarding the utility of the measures and their variability in community rehabilitation clients, which may inform larger studies in the future. A further limitation to this small trial is that despite randomization, groups were not balanced for all demographic features (e.g., a greater number of participants referred for falls in the intervention group) which may have affected outcomes. One participant withdrew from the trial due to discomfort wearing the activity monitor; however, this measure was otherwise tolerated well by participants. The Exercise Stage Assessment questionnaire and Assessment of Quality of Life instrument were accepted well by participants and researchers involved in this study. A number of participants found the Self-Efficacy for Exercise Scale challenging to complete due to its abstract nature, so alternatives, such as the simpler, 5-point Self-Efficacy for Physical Activity Scale (Marcus et al., 1992) should be considered for future use.

Participants involved in the study were recruited from community rehabilitation on a voluntary basis and thus may have had an increased interest in PA, which may have contributed to the relatively high rate of participation in PA by participants of the trial. "Interest in health" is a modifiable predictor of enrollment in PA promotion programs (Mills et al., 2001). Consideration of strategies to engage a broader range of eligible community rehabilitation clients to participate in this type of research would be necessary for future studies. Furthermore, additional screening to exclude those who are already sufficiently active could be considered in future trials, given limited benefit was evident in these participants. The brief, single-session intervention was designed to support viability of integrating such an intervention within current resources; however, the impact on service delivery and costs needs to be considered when designing future trials. The time taken to deliver such an intervention will influence the viability of its addition to routine care. It is a limitation of the current study that actual delivery time was not recorded.

Due to resource limitations, this study excluded potential participants who were unable to read and speak English; this population is at increased risk of low PA levels (Dassanayake et al., 2011) and would warrant inclusion in larger future studies. Furthermore, the literature supports the importance for PA for other groups excluded from this trial, such as those with cognitive impairment (Potter et al., 2011) and those not safe to walk outdoors independently, for example, poststroke (Saunders et al., 2014). Given these populations are significantly at risk of low levels of PA, their exclusion from this study may also help to explain the surprisingly high level of moderate–vigorous PA completed by the community rehabilitation participants studied. Future consideration to ensure inclusion of vulnerable populations is supported through the study design and intervention delivery, and would add substantial value to such an intervention.

Conclusion

It is feasible to deliver a brief intervention of PA counseling and education in the community rehabilitation setting. Over half of those screened were both eligible and interested, and the assessment and intervention protocol was well tolerated. A larger randomized controlled trial, powered to detect change in the secondary outcomes, is required to provide greater insight into the effect of such a brief PA counseling and education intervention on PA levels, stage of change, self-efficacy, and quality of life. Further refinement of the protocol, to include the addition of phone call or tailored mail-based follow-up, may be beneficial to assist in recall of information delivered and adherence to PA. Future studies must also consider strategies to target those with low levels of PA and to engage and support vulnerable subsets of the population, such as those with cognitive impairment and those who are unable to read and speak English.

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Chapter 4: Discussion and conclusion

4.1 Overview of main findings

The aim of this thesis was to optimise the PA levels of clients being discharged from community rehabilitation. More specifically to understand the effect of brief interventions to increase PA when delivered in health care settings other than primary care, and to specifically test the feasibility of delivering a brief intervention to increase PA in the community rehabilitation context.

Chapter one described the importance of being physically active, particularly for older adults and those with chronic disease. It also outlined the body of work around interventions to increase PA broadly and more specifically in these populations, including global and national guidelines, systematic reviews and reviews of reviews. The healthcare setting provides an important opportunity to reach older adults and those with chronic disease with interventions to increase PA, however reviews to date have focused only on the primary care setting [34, 35]. Brief interventions to increase PA, delivered in the primary care setting, have been demonstrated to increase self-reported PA in the short-term, their effect when delivered in other healthcare settings is unknown [17, 34, 35].

The systematic review in Chapter Two examined the effects of brief interventions to increase PA, when delivered in healthcare settings other than primary care. A meta-analysis of ten studies, revealed brief interventions in the healthcare setting to be effective at increasing self-reported PA, steps per day measured by pedometer and MET hours/week of PA in the medium-term. There was insufficient evidence regarding their

long-term impact. The wide variation in types of interventions studied makes it difficult to determine which intervention features optimise outcomes.

The study in Chapter Three tested the feasibility of delivering a brief intervention of PA education and counseling in the community rehabilitation setting. Participants in this feasibility randomised controlled trial received either one session of stage-of-change-based PA education and counseling in addition to written educational material (intervention), or education material alone (control), and were followed up three months following the intervention. Half of the eligible participants screened were interested in participating, 66% of those completing baseline measures expressed they had recently commenced regular PA or intended to begin regular PA in the next 6 months, and the assessment and intervention protocol was well tolerated. The study determined it was feasible to deliver a brief intervention of PA counseling and education in the community rehabilitation setting. However, a larger randomised controlled trial powered to detect change in the secondary outcomes, specifically objectively measured PA and patient reported outcomes, is required. Further refinement of the intervention protocol may be warranted to assist in clients' recall of information delivered and adherence to PA.

4.2 Strengths and limitations of the research undertaken for this thesis

The strengths of the research presented in this thesis include the robust methodology applied to both the systematic review and the feasibility study. The systematic review was conducted in accordance with PRISMA guidelines, including the application of an extensive search strategy, two independent reviewers selecting relevant articles and the

inclusion of only randomised controlled trials. For the feasibility study, strengths in the methodology include: the use of a randomised controlled trial design; random sequence generation; concealed allocation; and blinding of follow-up outcome assessment. The work presented in this thesis is novel. No systematic review to date has investigated interventions to increase PA exclusively in healthcare settings other than primary care. This work highlights the possibilities for the use of brief interventions to increase PA in many clinical settings and may inform implementation decision making. As a result, it may increase the reach of brief interventions to increase PA to older adults and adults with chronic disease. The intervention delivered in the feasibility study is, to our knowledge, the first of its kind to be studied in the community rehabilitation setting. Further, the brief intervention delivered was based on extensive review of the literature, with a clear intervention protocol provided for replication. The use of objective PA assessment also strengthens the quality of this study, by providing a more accurate insight into PA outcomes than the use of a self-reported measure alone [39].

Limitations of the work presented in this thesis includes shortcomings in the systematic review, in particular missing data and inconsistent methods of reporting in included studies, as a result it was difficult to draw definitive conclusions. The broad range of intervention settings, target populations and inclusion of disease specific education in the included studies, may limit the ability for findings to be generalized. The reliance on self-reported PA outcomes in included studies introduces the potential for recall bias [39]. Lastly, due to the wide variety of types of interventions studied, we were unable to determine the specific intervention factors which impacted the success of these interventions.

The feasibility study examined the effect of brief PA education and counseling specifically in the community rehabilitation setting; due to the varying structure of different healthcare systems, applicability to other settings may be limited. The feasibility study included only a relatively small number of participants and was not powered to detect change in any secondary outcome measures. As such a larger study is required to determine the clinical effectiveness of the intervention. A number of study design characteristics may have contributed to the relatively high rate of PA participation among trial participants, including: the voluntary basis of recruitment; inclusion of participants already in maintenance stage of change; and exclusion of participants in a number of vulnerable groups, such as those unable to read and speak English, those with cognitive impairment and those unable to mobilise safely. Consideration of strategies to address these factors is important for future studies in this field. Finally, poor recall of the intervention delivered suggests that the brief intervention delivered may have been too 'brief' and would have benefited from one or more follow-up sessions. More specific strengths and limitations are also outlined in Chapter Two and Three.

4.3 Key findings and recommendations for clinical practice

The work presented in this thesis has highlighted the importance of PA participation for older adults and adults with chronic disease. It has outlined the evidence base regarding interventions to increase PA both broadly and specifically in these populations, and the role the healthcare system must play in supporting these populations to participate in sufficient PA. The systematic review highlighted that some brief interventions delivered in healthcare settings, such as coronary care, cardiac rehabilitation and oncology

settings, are effective at increasing PA in the medium term. Finally, the feasibility study has provided evidence that it is feasible to deliver a brief intervention of PA education and counseling in the community rehabilitation setting.

Based on these findings, the following recommendations for clinical practice can be made:

1. Relevant clinicians in the healthcare setting, such as; medical practitioners, clinical psychologists, physiotherapists and exercise physiologists, should be working with older adults and adults with chronic disease to assess, and where necessary promote, participation in adequate PA to meet the PA and sedentary behaviour guidelines.
2. The use of brief interventions in healthcare settings other than primary care, to support participation in PA, should be considered in relevant contexts. Relevant contexts may include, however are not limited to; outpatient clinics, cardiology and oncology settings, and rehabilitation centres.
3. The implementation of brief interventions to support participation in PA is feasible and should be considered in the community rehabilitation setting.

4.4 Recommendations for research

Further research is needed to continue to advance the literature in this area. The recommendations for future research include:

1. Conduct a large randomised-controlled trial to investigate the effect of a brief intervention of PA education and counseling in the community rehabilitation

setting. This thesis identified that delivery of such an intervention is feasible in this context, however a larger trial powered to detect change in objectively measured PA is required to determine clinical effectiveness.

2. The protocol applied in the feasibility study (Chapter Three) warrants revision prior to being applied to any larger studies. Considerations for revision of this protocol are outlined separately below.
3. Studies assessing the efficacy of interventions to increase PA should, where possible, use objective measures of PA due to their reliability over self-reported outcomes. Such studies should also strive to assess long-term outcomes, of at least 12 months, in addition to short or medium term outcomes. This will allow for a higher quality evidence base and more definitive findings from systematic reviews in the future.
4. Researchers investigating the effect of brief interventions to increase PA should design 'brief interventions' in accordance with an accepted definition of brief intervention, such as the NICE guidelines, to allow for higher quality reviews of this body of work in the future.
5. Future research should assess the cost-effectiveness and resource utilization of delivering brief interventions to promote PA in healthcare settings other than primary care.

4.5 Revision of intervention protocol

The following recommendations are made for revision to the intervention protocol outlined in chapter three of this thesis for any future studies:

1. Recall of the brief intervention delivered in the feasibility trial was poor, the addition of follow up phone calls may be warranted. This strategy has been applied somewhat successfully in other health population groups such as patients with type two diabetes [40]. In this example follow-up phone calls were made at weeks one, three and seven post baseline assessment, to compliment a face-to-face counseling intervention. Significant improvements in PA were found on one self-report measure of PA (*F(2,196) = 6.568, P=0.002),* while another showed trends to increased PA for the intervention group however these did not reach significance (*F(2,97) = 2.499, p=0.087)*.
2. The time taken for intervention delivery should be recorded to assess the viability of integrating this type of intervention in routine care.
3. Participants in maintenance stage of change should be excluded from future trials, given limited benefit was evident in these participants, as deduced from participant interview data.
4. Strategies to include those less interested in PA should be considered. For example, inviting participation in the intervention towards the end of the patient's rehabilitation journey rather than at the beginning may assist a greater range of patients to feel capable of participating in this type of intervention.
5. Strategies to include more vulnerable populations, such as those unable to read and speak English, those with cognitive impairment and those unsafe to walk outdoors, should also be considered. Having the participant's own physiotherapist deliver the intervention, may support participation of those in more vulnerable categories. Their treating physiotherapist may be best able to

use strategies already in place to overcome language barriers and issues associated with cognitive impairment, such as use of accredited interpreters and carer support, and will have the greatest understanding of how to tailor PA advice to the needs of their individual client.

6. A number of participants found the Self-Efficacy for Exercise Scale challenging to complete due to its abstract nature, so alternatives such as the simpler 5-point Self-Efficacy for Physical Activity Scale [41] could be considered for in future work.

4.6 Concluding observations

Clinicians working in the healthcare setting have an important opportunity to work with older adults and those with chronic disease, to promote participation in PA and ultimately improve health outcomes for these populations. Even brief interventions to promote PA, delivered in the healthcare setting, can result in increased PA participation in these populations. Brief interventions are most likely able to be deliverable within existing service models and resources. The community rehabilitation setting provides an ideal opportunity to deliver brief PA interventions to older adults and adults with new and existing chronic disease. The feasibility of delivering a brief intervention of PA education and counseling in the community rehabilitation context has been examined and supported. Further research in this setting is now required to test the clinical efficacy of this intervention.

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