2016

Evaluating the impact of a falls prevention community of practice in a residential aged care organisation

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Publication Details

Francis-Coad, J. (2016). Evaluating the impact of a falls prevention community of practice in a residential aged care organisation (Doctor of Philosophy (School of Physiotherapy)). University of Notre Dame Australia. http://researchonline.nd.edu.au/theses/137

Chapter 2

Chapter 2:

The Effect of Complex Falls Prevention Interventions on Falls in Residential Aged Care Settings: A Systematic Review and Meta-Analysis

Preface

There is limited synthesised evidence for organisation wide approaches to delivering falls prevention interventions at multiple levels in RAC settings.

This chapter describes a systematic review and meta-analysis and is based on two manuscripts, the first of which is a published protocol:

Francis-Coad, J., Etherton-Beer, C., Naseri, C., & Hill, A-M. The effect of complex falls prevention interventions on falls in residential aged care settings: A systematic review protocol. *JBI Database of Systematic Reviews and Implementation Reports,* 15(2), 236-244. doi: 10.11124/JBISRIR-2016-002938 [see Appendix B])

Francis-Coad, J., Etherton-Beer, C., Burton, E., & Hill, A-M. The effect of complex falls prevention interventions on falls in residential aged care settings: a systematic review and meta-analysis. (Prepared for submission to a peer reviewed journal)

The author's version of the manuscripts is presented with modifications to suit the style and format of this thesis.

2.1 Abstract

Background

To synthesise the best available evidence for the effectiveness of complex falls prevention interventions delivered at two or more of the following levels: resident, site or organisation, on falls rates in the RAC population.

Methods

A systematic search of seven databases was undertaken including hand searches of reference lists of relevant articles. Papers published between January 1 1990 and May 31 2016 in the English language were considered for inclusion. Study designs included were randomised controlled trials, pseudo-RCTs, repeated measures and quasi-experimental studies with a pre/post design. In total 1930 articles were identified for consideration with 24 retrieved for full text review and 12 included. Two independent reviewers conducted critical appraisals using the Joanna Briggs Institute (JBI) Meta-Analysis of Statistics Assessment and Review (MAStARI) tools. The effectiveness of complex falls prevention interventions delivered at more than two levels compared to usual care was assessed using standard meta-analysis methods.

Results

Complex falls prevention interventions delivered at multiple levels in RAC populations did not show a significant effect in reducing falls rates [RR = -1.29; 95% CI (-3.01, 0.43)], or the proportion of residents who fell [OR = 0.76; 95% CI (0.42, 1.38)]. However, a sensitivity analysis suggested complex falls prevention interventions delivered with additional resources at multiple levels had a significant positive effect in reducing falls rates [RR = -2.26; 95% CI (-3.72, -0.80)].

Conclusion

Complex interventions delivered at multiple levels in the RAC population may reduce falls rates when additional staffing, expertise or resources are provided. Organisations may need to determine how resources can be allocated to best address falls prevention management. Future research should continue to investigate which combinations of multifactorial interventions are effective.

2.2 Introduction

Falls in the RAC sector are a major concern worldwide with rates reported to range between 3-13 falls per 1000 bed days (Cameron et al., 2012; Morley, Rolland, Tolson, & Vellas, 2012; Oliver et al., 2007; Rapp, Becker, Cameron, König, & Büchele, 2012; Rubenstein, 2006). One in two older people (residents) admitted to RAC have a fall within 12 months and 25%-30% of those sustain a physical injury (Burland, Martens, Brownell, Doupe, & Fuchs, 2013; Oliver et al., 2007). Significant physical injuries, such as hip fracture, have an estimated incidence rate of between 3% and 5% annually (Rapp, Becker, Lamb, Icks, & Klenk, 2008; Rigler et al., 2011; Vlaeyen et al., 2015). These types of injuries frequently lead to a loss of independence. Data from nursing homes in Victoria, Australia gathered from July 1 2000 to Dec 31 2012 reported that of 1296 deaths from external causes (including falls, suicide and choking) 1,155 (89.1%) resulted from falls (Ibrahim, Murphy, Bugeja, & Ranson, 2015). The psychological impact of falling can also result in loss of confidence and reduced quality of life, with researchers reporting that even with rehabilitation interventions, many older people who have fallen never regain their former level of confidence or independence (Oliver et al., 2007; Oliver & Masud, 2004; Rubenstein, 2006).

At health care systems level the financial burden of falls is a current and future concern (Haines et al., 2013; Heinrich, Rapp, Rissmann, Becker, & König, 2010), in part due to projected population ageing, with estimates indicating by 2064 there will be 9.6 million people aged 65 and above and 1.9 million aged 85 and above (Australian Institute of Health and Welfare, 2012). Falls data from New South Wales during 2006-2007 showed that although older people residing in aged care facilities represented only 5.5% of the total population of older people in that state, they contributed 15% of the total costs of fall injuries in that state (Watson, Clapperton, & Mitchell, 2011). The estimated cost of falls per person in RAC settings in Australia (2008 base year) was reported as $AUD 1887 (Haines et al., 2013). Thus preventing falls in the RAC sector is part of an Australian Government national initiative (Lord, Sherrington, Cameron, & Close, 2011; National Public Health Partnership, 2004).

Falls prevention in any setting is challenging as it involves a number of interacting components making both intervention and evaluation complex (Anderson, Issel, & McDaniel, 2002; Craig et al., 2008). The cause of most falls is complex

involving combinations of risk factors present in an individual older person, such as reduced strength and balance, presenting at a specific moment in the context of an external environment that can also present risks, such as a slippery floor (Cameron et al., 2012; Morley et al., 2012). Older people residing in aged care facilities are recognised as a population with high falls risk due to many individuals having a history of falls, activities of daily living disability, cognitive and visual impairments, multiple medications, pain, urinary incontinence and reduced strength and balance (Cameron et al., 2012; Deandrea et al., 2013; Morley et al., 2012; Rubenstein, 2006). A European study of 57 long term care homes with over 4000 residents observed cognitive impairment in 68% of residents and activities of daily living disability in 81.3% (Onder et al., 2012), suggesting that older people in residential care are particularly vulnerable and often lack the capability to reduce their risk of falling without prompting or assistance. The environment can also impact resident safety; with the highest incidence of falls occurring in residents bedrooms (Nitz et al., 2012; Rapp et al., 2012) or bathrooms (Rapp et al., 2012). Other factors within the RAC setting, such as staff and organisational philosophy and culture, can also influence resident safety (Dyer et al., 2004; Etherton-Beer, Venturato, & Horner, 2013).

Researchers working in this field have trialled a range of different intervention approaches to address falls among this older population from single strategies, including exercise and medication review, to multifactorial approaches delivered by a multidisciplinary staff (Cameron et al., 2012; Nazir et al., 2013; Speechley, 2011). Two recent meta analyses examining falls prevention programs in RAC populations showed different findings; the Cochrane systematic review (Cameron et al., 2012) concluded that providing vitamin D supplementation for residents with low vitamin D levels reduced the rate of falls by 37%, 95% CI [0.46-0.86] but not an individual's risk of falling whilst Vlaeyen et al. (2015) reported that multifactorial fall prevention interventions decreased falls by 33%, 95% CI [0.55-0.82] and the number of people with recurrent falls by 21% (95% CI 0.65-0.97). However whilst these systematic reviews focused on single, multiple or multifactorial intervention approaches their inclusion criteria differed; the former included some mixed population studies (Cameron et al., 2012) whilst the latter included only nursing home populations and randomised or cluster randomised controlled designs (Vlaeyen et al., 2015).

Randomised designs are a challenge in RAC populations for several reasons; including recruitment, adherence to interventions and sustained participation (Nyman & Victor, 2011). High levels of cognitive impairment make consent to participation an issue, thus in RAC settings approximately 49% of residents are recruited and by 12 months 16% are lost, largely due to mortality. Adherence to multifactorial falls prevention intervention components ranged from 11%-93% across studies reviewed by Nyman and Victor (2011) and by 12 months only a third of those in residential care were likely to be still adhering to interventions. This suggests that results from RCTs in RAC populations must also be interpreted with caution and other designs that are flexible and inclusive may also provide useful evidence (Nyman & Victor, 2011; Oliver et al., 2007).

Since residents are frail and generally require assistance with activities of daily living, implementing falls prevention evidence-based practice into a RAC setting predominantly requires staff to master the content of such a program and apply it to the care of their residents (Berta et al., 2010; Craig et al., 2008). Whilst the capacity to deliver organisation wide approaches to address complex issues, such as effective falls prevention, is strongly influenced by an organisation's leadership and culture to support change (Berta et al., 2010; Etherton-Beer et al., 2013). This requires connections between managers, staff and researchers to develop effective policy through interdisciplinary problem solving and discussion that in turn enables staff behavioural change (Colón-Emeric et al., 2006; Colón-Emeric et al., 2013; Michie, van Stralen, & West, 2011). Consequently some researchers have suggested that organisations need to make changes at multiple levels using a systematic approach to enable evidence to be translated into practice (Australian Commission on Safety and Quality in Healthcare, 2009; Berta et al., 2010; Craig et al., 2008; Panel on Prevention of Falls in Older Persons, American Geriatrics Society & British Geriatric Society, 2011; Wensing, Wollersheim, & Grol, 2006). These interventions that are delivered across multiple levels have been characterised as complex (Craig et al., 2008). For falls prevention interventions delivered in RAC settings these levels can be categorised as: resident, site and organisation and if at least two or all of these levels are targeted then the intervention can be considered complex. Resident level describes intervention delivery involving resident participation, such as the resident undertaking an exercise program or having a medication review. Site level delivery describes interventions that target RAC staff, such as giving staff falls prevention education or undertaking safety maintenance on patient equipment. Organisation level describes interventions involving RAC management

participation in bringing about practice change, such as revising professional staff roles and reviewing policy or processes around falls prevention. A limited number of studies have evaluated complex multiple level interventions that included elements that addressed aspects of organisational change including, reassignment of staff roles and adoption of best practice at a site level (Kerse, Butler, Robinson, & Todd, 2004; Nitz et al., 2012; Rask et al., 2007). Such studies include; a participatory action research design that trained a falls resource nurse to lead the implementation of evidence-based strategies resulting in a reduction in the proportion of fallers in RAC facilities (Nitz et al., 2012) whilst a falls management program targeting cultural change and quality improvement had no effect on falls (Rask et al., 2007). Another study, led by a falls coordinator in similar RAC settings, used tailored falls risk management delivering best practice interventions found that falls rates increased (Kerse et al., 2004). These variations in findings lead to uncertainty about the effectiveness of complex multi-level approaches.

It has also been suggested that RAC facilities may require additional resources to facilitate translation of falls prevention evidence into practice (Kennedy et al., 2012; Kerse, 2010). This will be increasingly challenging due to the financial constraints of the RAC industry, which has recently been reported in the bulletin Australian Ageing Agenda (Mathewson, 2016).

To our knowledge there were no recent systematic reviews either published or underway that synthesised the evidence for effectiveness of complex falls prevention interventions delivered at multiple levels in the RAC population. The absence of synthesised evidence for organisation wide approaches to falls prevention in the RAC setting justifies this current review. Given that clinicians and falls researchers are now undertaking and evaluating complex multiple level interventions there is a need to combine these data systematically. The aim of this review was to synthesise the best available evidence for the effectiveness of complex falls prevention interventions, implemented at two or more of the following levels: resident, site or organisation, on falls in the RAC population.

2.3 Methods

This systematic review and meta-analysis was conducted according to an *a priori* protocol (under second review for publication at the JBI Database of Systematic Reviews and Implementation Reports) (see Appendix B).

2.3.1 Participants

Studies were included if they met all of the following criteria: participants were aged 65 years of age or older or the mean age of the group was over 65 years and they resided in long-term care accommodation providing 24-hour supervision and/or care assistance.

Studies were excluded if they were conducted in a setting that was community-based, assisted living in retirement communities, retirement homes, continuing care retirement centres, a palliative care site, transition care or in a hospital. It has been found by other falls researchers that the participant characteristics and the environment differ between these settings and hence require different falls prevention interventions (Cameron et al., 2012).

2.3.2 Interventions

Studies were included if they evaluated complex falls prevention interventions. Complex falls prevention interventions were defined as those delivered across at least two or all of the following levels: resident, RAC site and RAC organisation. These levels were classified based on the adapted works of Wensing et al. (2006) and Quigley et al. (2010) and are described in Table 2.1.

Table 2.1 Classification of Falls Prevention Interventions by Level of Delivery.

Delivery level	Intervention
Resident	Falls risk factor assessment
	Post-fall assessment
	Medication modification
	Orthostasis management
	Prescribed exercises e.g. balance, strength, gait training
	Prescribed assistive devices e.g. walking aid
	Hip protectors
	Continence management
	Falls prevention education
	Vitamin D supplementation
	Restraint minimisation
Site	Environmental audits or modifications
	Staff education or training
	Safety equipment provision e.g. low-low beds
	Equipment maintenance
	Referrals to other health professionals e.g. Optometrist
Organisation	Revision of professional roles[a]
	Implementation of multidisciplinary falls prevention teams or committees
	Support for staff membership of quality improvement collaboratives or communities of practice
	Implementation of falls prevention policy, process checklists or tools
	Implementation of knowledge management systems e.g. ICT supporting resident care

Note. ICT = Information and communication technology, [a]Changes to a health professional's tasks or responsibilities

Resident level described intervention delivery involving resident participation or compliance similar to Quigley et al. (2010). Site level delivery described interventions at a proxy level engaging RAC staff in undertaking falls prevention education or practice change to effect resident outcomes. We considered interventions such as modifying the environment layout and safety maintenance on patient equipment to be decided at site level, involving RAC staff rather than organisation level as described by Quigley et al. (2010). At organisational level we considered Wensing et al.'s (2006) focused review describing the organisational changes directed at staff practices to improve patient care a better fit for our review criteria, as they reflected management participation. Therefore,

organisation level described interventions involving RAC management participation in bringing about practice change. Interventions delivered at any of the levels included multiple or multifactorial falls prevention interventions delivered by single discipline, multidisciplinary staff teams or quality improvement collaboratives. An example of an intervention delivered at three levels could be that residents may receive vitamin D supplementation and hip protectors, the site may provide falls prevention education for staff and the organisation may revise its professional staff roles to lead falls prevention change.

2.3.3 Comparators

Studies that compared interventions delivered at two or three levels (resident, site and/or organisation) with a control group were included. In addition, studies that offered no comparison, a passive comparison (such as no treatment, standard care), or an active comparison (such as variation of the intervention) were considered.

2.3.4 Outcome Measures

Studies were included if an outcome measure related to falls prevalence was used and outcomes were measured before and after the intervention period. Outcome measures related to falls prevalence included the number of falls, the rate of falls (expressed as the number of falls per 1000 occupied bed days) and the risk of falling (expressed as the number of participants who fell); the number of injurious falls, the rates of injurious falls (expressed as the number of falls with injury per 1000 occupied bed days). Studies that measured falls rates as secondary outcome measures were also included if they provided data from which the falls rate or injurious falls rate could be calculated.

The study designs considered were both experimental and quasi-experimental designs, including randomised controlled trials, controlled clinical trials, experimental studies where randomisation had been used, comparative studies without randomisation, cohort and pre post designs. Studies were only included if they contained repeated measures or compared an intervention against standard treatment, no treatment or another intervention.

Studies published in the English language from January 1 1990 to May 31 2016 were considered for inclusion. The phenomena of interest, which is the incidence of falls in the RAC population, began to be addressed in published studies from around 1990. Falls prevention strategies which involved concepts to engage healthcare organisations and employees in improving outcomes were also conceived after 1990 (Lave & Wenger, 1991), hence the selection of the search date parameter.

2.3.5 Data Sources and Search Strategy

This review used a three-step search strategy. An initial limited search of MEDLINE (Pubmed) and CINAHL Plus with full text (EBSCO) using initial key words falls, falls prevention, residential aged care and nursing homes was undertaken. Text words contained in the title and abstract of these identified studies together with index terms describing these studies were used to construct the second search step, undertaken in seven databases: The Cochrane Central Register of Controlled Trials (CENTRAL) (The Cochrane Library, latest issue), The JBI Database of Systematic Reviews and Implementation Reports, Medline, CINAHL, EMBASE, AMED and Psych INFO. The search for unpublished studies included an electronic search of: trials registers Current Controlled Trials (http://www.controlled-trials.com) and the National Institute of Health Clinical Database (http://clinicaltrials.gov), Universal Index of Doctoral Dissertations in Progress, Mednar, Grey Literature Report and Google. The third search step reviewed reference lists of all identified studies for relevant additional studies not previously captured (see Appendix C).

2.3.6 Study Selection

Studies identified from the database searches were examined to ensure that they met the inclusion criteria using the title and abstract descriptions. Eligibility assessment using full text retrieval was then undertaken to determine if inclusion criteria were met. Any studies excluded were recorded with reasons (see Appendix D).

2.3.7 Quality Assessment

Papers selected for critical appraisal were assessed by two independent reviewers for methodological quality prior to inclusion in the review, using standardised critical appraisal instruments from the Joanna Briggs Institute Meta-Analysis of

Statistics Assessment and Review Instrument (JBI-MAStARI) as shown in Appendix B. Data were extracted and quality assessed by one reviewer and checked by a second reviewer. Disagreement was resolved by discussion between the two independent reviewers. A third independent reviewer was available for arbitration should a consensus not have been reached.

2.3.8 Data Extraction

Quantitative data were extracted from the selected studies by two independent reviewers using the standardised data extraction tool from the JBI-MAStARI (see Appendix B). The data extracted included details about participants and setting, study design and duration, sample size and the level and type of interventions delivered; including whether interventions were delivered at resident, site or organisation level. Falls outcomes extracted included the number of falls, falls rates, the number of older people who fell, the number of injurious falls and injurious falls rates. Data were only extracted on injurious falls if soft tissue injuries and fractures were included. The full data extraction is detailed in Appendix E.

2.3.9 Data Synthesis

Quantitative data from eligible studies were pooled in statistical meta-analyses using Review Manager (Version 5.3, 2014). All results were subject to double data entry. Statistical analysis was undertaken for falls rates, number of fallers and injurious falls rates (see Appendix E). All studies were analysed in terms of primary outcomes where data were available, regardless of their settings or combinations of intervention. Heterogeneity was assessed using a combination of visual inspection of the Forest plot along with consideration of the Chi-squared test and the I^2 statistic (Higgins, Thompson, Deeks, & Altman, 2003). When the I^2 statistic was greater than 50% a random effects model was applied as authors were aware of the uncertainty of the homogeneity of RAC resident populations and interventions delivered. For continuous outcomes the mean difference, standard deviation and standard error were calculated using the inverse variance DerSimonian and Laird method (DerSimonian & Laird, 1986). Mean difference was used in the meta-analysis, however results are presented as risk ratios or odds ratios (their original metric) (Higgins & Green, 2011). The results for dichotomous outcomes (fallers) were analysed using Mantel-Haenszel's random effects model

(Higgins & Green, 2011). Sub group analyses were undertaken based on whether additional staff or resources were allocated or obtained to participate in the intervention. Statistical significance was set at $p \leq .05$ for all analyses (two-sided). Where statistical pooling was not possible the results were presented as a narrative synthesis.

2.4 Results

The three step search strategy identified 1930 studies for consideration, 24 studies were retrieved for full text review, 12 studies were included for critical appraisal and seven were eligible for meta-analysis, as shown in the flow chart adapted from Moher, Liberati, Tetzlaff, and Altman (2009) (see Figure 2.1).

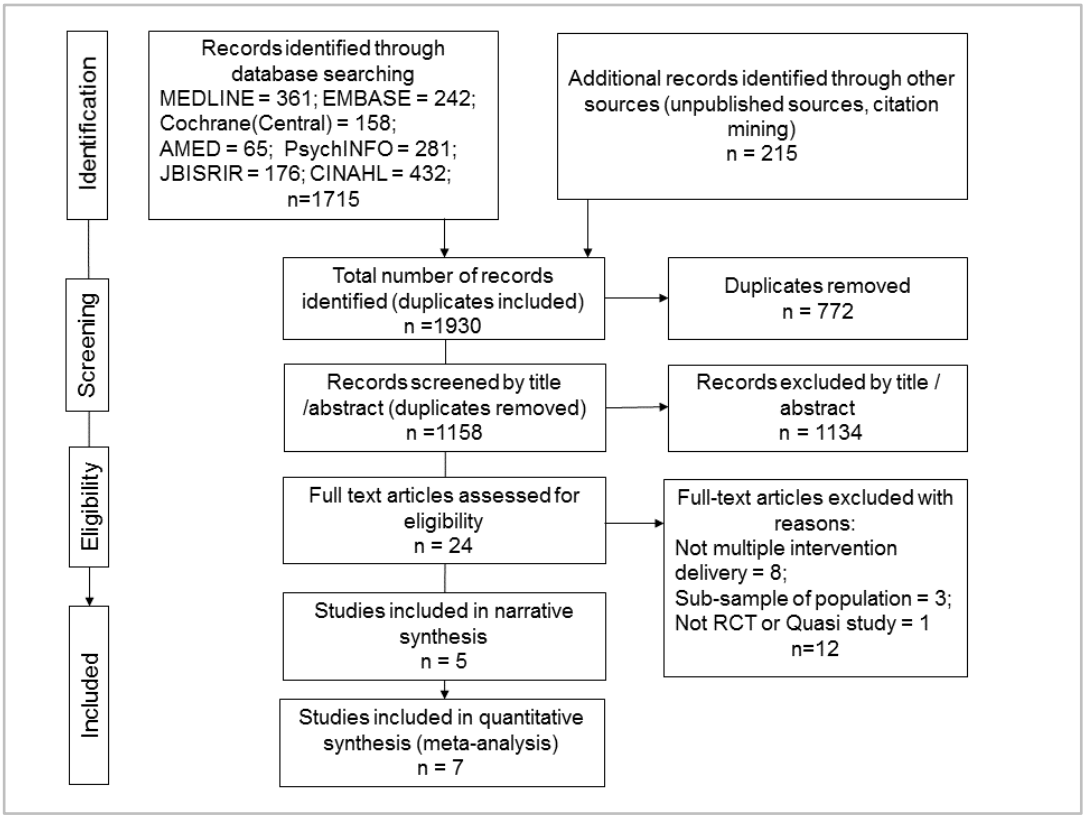

Figure 2.1 Flowchart Showing Selection of Studies Included in the Review.

2.4.1 Study Characteristics

The characteristics of the 12 included studies are described in Table 2.2.

Seven studies were cluster randomised controlled trials (Becker et al., 2003; Dyer et al., 2004; Jensen, Lundin-Olsson, Nyberg, & Gustafson, 2002; Kerse et al., 2004; McMurdo, Millar, & Daly, 2000; Ray et al., 2005; Ray et al., 1997), two were

quasi-experimental pre-post with control group (Burland et al., 2013; Rask et al., 2007) and the remaining three quasi-experimental pre-post design (Colón-Emeric et al., 2006; Hofmann, Bankes, Javed, & Selhat, 2003; Nitz et al., 2012). Five studies were conducted in the USA, two in the UK, and the remainder in Australia, New Zealand, Canada, Germany and Sweden. The number of RAC facilities included in the 12 studies ranged from one to 112 with the mean age of residents being greater than 80 yrs. Studies included were conducted in long term care facilities for older people providing 24 hour supervision and care assistance as assessed. Study follow up times ranged from 34 weeks (Jensen et al., 2002) to 24 months (Nitz et al., 2012). Eight studies included a fall or injurious fall definition (Becker et al., 2003; Jensen et al., 2002; Kerse et al., 2004; McMurdo et al., 2000; Nitz et al., 2012; Rask et al., 2007; Ray et al., 2005; Ray et al., 1997) and seven studies followed recommended methods for gathering falls data (Becker et al., 2003; Burland et al., 2013; Dyer et al., 2004; Jensen et al., 2002; Kerse et al., 2004; McMurdo et al., 2000; Nitz et al., 2012).

2.4.2 Study Interventions

The interventions delivered at two or three levels are presented in Table 2.2. Nine studies (Becker et al., 2003; Burland et al., 2013; Colón-Emeric et al., 2006; Hofmann et al., 2003; Jensen et al., 2002; Kerse et al., 2004; Nitz et al., 2012; Ray et al., 2005; Ray et al., 1997) delivered falls prevention interventions at three levels (resident, site and organisation). Three studies delivered falls prevention interventions at two levels; two delivered resident and site level interventions (Dyer et al., 2004; McMurdo et al., 2000) and one delivered site and organisation level interventions (Rask et al., 2007). Resident level interventions included falls risk assessment, exercise program, medication review and provision of mobility aids or hip protectors. Site level interventions included staff education, environmental modifications (audit, install or repair) and referral to a health professional or service. Organisation level interventions included changes to falls or falls prevention policy

Table 2.2 Characteristics of Included Studies in the Systematic Review.

Criteria	Included studies
	Becker 2003
Title	Effectiveness of a multifaceted intervention on falls in nursing home residents

Criteria	Included studies
Methods	Prospective cluster randomised controlled trial
Setting	6 nursing homes, Germany
Participants	981 residents >60 yrs, Mean Age yrs (*SD*) 83.5(7.5) intervention group, 84.3(6.9) control group
Intervention	Multifaceted, 12 months
Resident level	Resident education on fall prevention, Exercise (progressive balance and resistance 75 minutes x 2 weekly), Hip protectors. Residents chose any combination of interventions for any selected duration
Site level	Staff education on fall prevention (60 minutes) and monthly feedback on falls outcomes, environmental modification (76 items audited)
Organisational level	Trained nurses from within participating nursing homes. Telephone hotline to experts.
Control	No specific falls prevention program activities
Falls outcome measures	Falls ✓ fallers ✓ injurious falls ✗ (also measured recurrent fallers and hip fractures only)
Key results	Significant reduction in falls rates (p<.001), residents that fell (p = .038) and residents that fell more than twice (p = .015)
Notes	Included a fall definition, additional resources provided during intervention
	Burland 2013
Title	The evaluation of a fall management program in a nursing home population
Methods	Quasi-experimental, pre-post, comparison group design
Setting	12 nursing homes, Canada
Participants	5 intervention nursing homes (196 beds) 7 control (200 beds), 1046 residents
Intervention	Fall management program (site level), 3 years
Resident level	Falls risk assessment, restraint minimisation, prompted voiding, exercise, nutrition and medication reviews, education
Site level	Environmental audits, assistive devices, staff education
Organisational level	New tools and processes including: program guide, assessment tools, checklists, educational resources and a post-fall protocol
Control	Usual care (no formal falls management program in place)
Falls outcome measures	Falls ✓ fallers ✗ injurious falls ✓
Key results	Falls rates trended upwards in the intervention group pre and post measures but did not reach significance, injurious falls remained unchanged and hospitalized falls decreased significantly. Intervention group had significantly less injurious falls in post intervention period (p = .022)
Notes	No site fall definition included but fall data extraction defined by data set codes. Intervention delivered using existing resources

Criteria	Included studies
	Colón-Emeric 2006
Title	Translating evidence-based falls prevention into clinical practice in nursing facilities: results and lessons learned from a quality improvement collaborative
Methods	Naturalistic quasi-experimental pre/post design
Setting	36 nursing homes, USA
Participants	36 nursing homes with 353 non-participating nursing homes considered as controls
Intervention	"Change package", 9 months
Resident level	Falls risk assessment, medication review, supplemented vitamin D and calcium, correction of orthostatic hypotension, hip protectors, post fall assessment
Site level	Staff education, monthly environmental assessment including equipment repair, labelling high risk residents and PT referral.
Organisational level	2 to 3 nursing home staff became QIC members, Tool kit to support change
Control	Usual care (not participating in QIC)
Falls outcome measures	Falls ✓ fallers ✓ injurious falls ✗ (primarily measured changes in clinical practice)
Key results	No significant change in falls rates or proportion of residents who fell. Self-reported falls rates showed a decline from 6.1 to 5.6/1000 resident days ($p = .31$) but falls rates measured by chart abstraction increased slightly ($p = .17$). There was no significant association between the proportion of fallers and level of site participation. Compliance with screening, labelling, risk assessment and medication review showed only moderate improvement (evidenced by chart abstraction). Significant increase in vitamin D prescription ($p = .03$) and decrease in sedative hypnotics prescribed ($p = .04$). No change in benzodiazepine, neuroleptic or calcium use.
Notes	Participating facilities used a variety of fall definitions but none were reported. Some self report and chart abstraction from MDS, no raw falls data
	Dyer 2004
Title	Falls prevention in residential care homes: a randomised controlled trial
Methods	Cluster randomised trial
Setting	20 residential care homes, England
Participants	196 residents, Mean Age yrs (*SD*) 87.4(6.9) intervention group, 87.2(6.9) control group
Intervention	Multifactorial program for three months, follow up 12 months
Resident level	Risk factor and medical assessment, progressive group exercise program 3 x 40 minutes per week for 3 months (83 participants), or individual program for frailer/cognitively impaired residents, medication review

Criteria	Included studies
Site level	Environmental modifications, staff education, referral to optician and podiatrist
Organisational level	✗
Control	No intervention, visit by researcher every 3 weeks to collect data only
Falls outcome measures	Falls ✓ fallers ✓ injurious falls ✗ (also measured recurrent fallers and fractures only)
Key results	Modest reduction in falls rates in intervention group but not statistically significant (p = .27), no significant difference in the proportion of residents who fell (p = .94)
Notes	No fall definition included, additional resources provided during intervention
	Hofmann 2003
Title	Decreasing the incidence of falls in the nursing home in a cost-conscious environment: a pilot study
Methods	Prospective time-services study
Setting	1 nursing home, USA
Participants	120 residents
Intervention	Combined interventions
Resident level	Restorative activity program (entertainment based), hip protectors, provision and repair of mobility aids, medication review
Site level	Staff education, environmental modifications, repair of mobility aids
Organisational level	Multidisciplinary falls committee formed. Shift changes to increase staffing at times of high fall occurrence (no additional staff members), OT to provide post fall assessment, Post fall conferences.
Falls outcome measures	Falls ✓ fallers ✗ injurious falls ✓ (measured hip fractures only)
Key results	A significant reduction in number of falls was reported (p<.001) and falls resulting in fracture trended downwards but the difference was not significant. Post intervention falls on evening and night shifts reduced significantly (p<.001)
Notes	No fall definition. Retrospective comparison, information on resident compliance with the intervention was not available
	Jensen 2002
Title	Fall and injury prevention in older people living in residential care facilities a cluster randomized trial
Methods	Cluster randomised trial
Setting	9 residential care facilities, Sweden
Participants	402 residents >65 yrs, Mean Age yrs (range) 83(65-97) intervention group, 84(65-100) control group
Intervention	11 week multidisciplinary program, follow up 34 weeks

Criteria	Included studies
Resident level	Individualised exercise program 2-3 x per week, assistive device prescription, medication review, hip protectors
Site level	Staff falls prevention education, environmental modifications, assistive device repairs
Organisational level	Implementation of falls team meeting and post fall conference
Control	Received usual care only
Falls outcome measures	Falls ✓ fallers ✓ injurious falls ✓ (also measured recurrent fallers)
Key results	Total number of falls and number of residents who fell reported as significantly decreased (no p values were reported)
Notes	Included a fall and injurious fall definition. Additional resources provided (8 physiotherapy staff employed during intervention (200 hrs/wk) and 3 during follow up period (10 hrs/wk)
	Kerse 2004
Title	Fall prevention in residential care: A cluster, randomized, controlled trial
Methods	Cluster randomized controlled trial
Setting	14 residential care homes in New Zealand
Participants	617 residents, Mean Age yrs (*SD*) 83.2(10.6)
Intervention	Falls risk management program, 12 months
Resident level	Falls risk assessment with individualised care plan strategies targeting identified risk factors
Site level	Reminder logos for risk level and strategy adoption, environmental assessment, referral to relevant health professionals
Organisational level	Falls co-ordinator appointed, falls risk assessment tool and falls/injury prevention manual implemented
Control	Usual care, monthly visit by researcher to audit fall surveillance
Falls outcome measures	Falls ✓ fallers ✓ injurious falls ✓ (also measured recurrent fallers)
Key results	Falls rates increased significantly in the intervention program homes compared with control group homes and the proportion of residents who fell also increased significantly ($p<.018$) following adjustment for clustering, baseline fall rate, site dependency level. There was no statistically significant difference in injurious fall rates between the two groups
Notes	Included a fall and injurious fall definition, utilised existing resources to deliver the intervention
	McMurdo 2000
Title	A randomized controlled trial of fall prevention strategies in old peoples' homes
Methods	Cluster randomised controlled trial
Setting	9 nursing homes, UK

Criteria	Included studies
Participants	133 residents, Mean Age yrs (*SD*) 84(7)
Intervention	Multifactorial, 12 months follow up
Resident level	Falls risk assessment including medication review and visual acuity test, supervised exercises (not tailored individually): seated balance exercises, strength and flexibility 30 minutes x 2 weekly for 6 months
Site level	Environmental modification (lighting levels), optometry referral
Organisational level	✗
Control	Received reminiscence therapy (targeting social interaction) twice weekly for six months
Falls outcome measures	Falls ✓ fallers ✓ injurious falls[a] ✓ (also measured recurrent fallers)
Key results	No significant differences in falls rates (p = .165) or proportion of residents who fell (p = .088)
Notes	Included a fall definition, high drop out rate compromised power to detect an effect, excluded residents with higher levels of cognitive impairment (MMSE <12), utilised existing resources
	Nitz 2012
Title	Outcomes from the implementation of a site-specific evidence-based falls prevention intervention program in residential aged care
Methods	Prospective cohort study pre/post design
Setting	9 residential aged care facilities, Australia
Participants	670 residents (650 staff)
Intervention	External project team facilitated an action research approach to deliver multifactorial interventions that varied dependent on the needs of the participating facilities, 24 months (included a 6 month preintervention phase)
Resident level	Prioritised strategies identified at audit e.g. hip protectors
Site level	Falls prevention activity audit, low-low beds and other prioritised strategies identified at audit including environmental modification, staff education
Organisational level	A falls resource nurse was trained to lead the project at their site, falls prevention action research group formed and met fortnightly at each site
Falls outcome measures	Falls ✓ fallers ✓ injurious falls ✗ (also measured recurrent fallers)
Key results	Reduction in the proportion of fallers (p = .044) and single fallers (p = .04), no effect on number of falls due to confounding by residents who fell multiple times, variation in positive outcomes from interventions by site
Notes	Included fall definition, additional resources staffing 0.2FTE and equipment budget funded during intervention

Criteria	Included studies
	Rask 2007
Title	Implementation and evaluation of a nursing home fall management program
Methods	Quality improvement project
Setting	19 nursing homes, USA within single organisation
Participants	All residents of 19 participating nursing homes (convenience sample), 23 non-intervention nursing homes considered controls
Intervention	Falls management program (quality improvement and culture change)
Resident level	✗
Site level	Intensive staff education including problem solving and safety culture training
Organisational level	Advanced practice nurse consultation, falls nurse co-ordinator and interdisciplinary falls team elected at participating facilities, extensive falls prevention tools (manuals, video, forms and brochures)
Falls outcome measures	Falls ✓ fallers ✗ injurious falls[a] ✓ (primarily measured process of care documentation including restraint use)
Key results	No significant difference in falls rates in intervention homes ($p = .59$), fall related care process documentation improved significantly and restraint use decreased ($p<.001$), serious fall injuries only were reported with no significant difference ($p = .79$)
Notes	Fall and injurious fall defined, additional external resources utilised (Advanced practice nurse or expert consult)
	Ray 1997
Title	A randomised controlled trial of a consultation service to reduce falls in nursing homes
Methods	Cluster randomised controlled trial
Setting	14 nursing homes, USA
Participants	482 residents, Mean Age 83 yrs
Intervention	External falls consultation service (multidisciplinary assessment) with 12 month follow up
Resident level	Comprehensive individual falls risk assessment including medication review, gait and transfer safety training
Site level	Environmental modification
Organisational level	Falls co-ordinator appointed at participating sites
Control	Usual care
Falls outcome measures	Falls ✗ fallers ✗ injurious falls[b] ✓ (also measured recurrent fallers)
Key results	A non-significant trend towards a reduction in the rate of serious injurious falls ($p = .220$) was observed between groups

Criteria	Included studies
Notes	Included a fall definition, only falls injuries leading to hospital admission, ED or physician visit were included, additional resources (external staff) employed in intervention delivery, included high falls risk residents who had fallen only.
	Ray 2005
Title	Prevention of fall-related injuries in long-term care randomized
Methods	Cluster randomised controlled trial
Setting	112 aged care facilities, USA
Participants	10,558 residents >65 yrs (not bedridden) mean age 84 yrs
Intervention	Intensive 2 day safety training program with 12 month follow up
Resident level	Medication review, transfers and ambulation
Site level	Environmental modification, equipment review (wheelchairs and walking aids), staff training
Organisational level	Falls team co-ordinated by a nurse appointed at participating sites, training resources implemented (manual, video, assessment tools), telephone calls to falls team co-ordinator (mean of 24 calls per site)
Control	Usual care
Falls outcome measures	Falls ✗ fallers ✗ injurious falls[b] ✓ (also measured recurrent fallers)
Key results	There was a trend towards an increase in serious fall related injuries but the difference was not significant (p = .84)
Notes	Included serious injurious fall definition

Note. QIC = Quality improvement collaborative, MDS = Minimum data set, ✓ = Presence of outcome measurement, X = Absence of outcome measurement

[a] serious fall injuries only were reported, [b] only falls injuries leading to hospital admission, ED or physician visit were included

2.4.3 Critical Appraisal

Assessment for risk of bias was completed for seven RCTs as shown in Table 2.3. Two studies scored six out of 10 (McMurdo et al., 2000; Ray et al., 2005), four studies scored seven out of 10 and one study scored nine out of 10 (Kerse et al., 2004). True random assignment to treatment groups was performed in five (71.4%) of the included studies, four (57.1%) studies concealed allocation to treatment from the allocator and six (85.7%) studies described and included outcomes of people that withdrew in their analysis. In all seven studies (100%) the control and treatment groups were similar at entry, received identical treatment apart from the named intervention and measured outcomes in the same way for both groups. Measurement of outcomes was deemed reliable in six (85.7%) studies with five (71.4%) using appropriate statistical

analysis. Blinding of assessors to treatment groups was reported in three (42.9%) studies with none (0%) blinding participants to treatment allocation.

Table 2.3 Results of Critical Appraisal of Included Randomised Controlled Trials.

Study	Q1[a]	Q2[b]	Q3[c]	Q4[d]	Q5[e]	Q6[f]	Q7[g]	Q8[h]	Q9[i]	Q10[j]
Becker 2003	Y	U	U	Y	N	Y	Y	Y	Y	Y
Dyer 2004	Y	N	Y	Y	N	Y	Y	Y	Y	U
Jensen 2002	U	N	Y	Y	N	Y	Y	Y	Y	Y
Kerse 2004	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
McMurdo 2000	U	U	U	Y	Y	Y	Y	Y	Y	N
Ray 1997	Y	U	Y	Y	U	Y	Y	Y	N	Y
Ray 2005	Y	N	U	N/A	Y	Y	Y	Y	Y	Y

Note. Y = Yes, N = No, N/A = Not applicable, U = Unclear.

[a] Was the assignment to treatment groups truly random?

[b] Were participants blinded to treatment allocation?

[c] Was allocation to treatment groups concealed from the allocator?

[d] Were the outcomes of people who withdrew described and included in the analysis?

[e] Were those assessing outcomes blind to the treatment allocation?

[f] Were the control and treatment groups comparable at entry?

[g] Were groups treated identically other than for named interventions?

[h] Were outcomes measured in same way for all groups?

[I] Were outcomes measured in a reliable way?

[j] Was appropriate statistical analysis used?

The five quasi experimental designs were assessed for risk of bias as shown in Table 2.4. Assessment for risk of bias for quasi-experimental designs showed variation in the overall quality. Two studies scored seven (Burland et al., 2013) and eight (Nitz et al., 2012) out of nine respectively, one scored five out of nine (Rask et al., 2007), one scored three out of nine (Hofmann et al., 2003) and the other two out of nine (Colón-Emeric et al., 2006). All five studies (100%) clearly stated cause and effect, four (80%) studies provided treatment similarly other than the intervention and follow up was completed or strategies to deal with losses were employed. Three (60%) studies reported participants under comparison were similar and measurement of outcomes was performed in the same way for all participants. In two (40%) studies participants received similar treatments other than the intervention, a control group was included,

multiple measurements of outcomes pre and post exposure were reported, outcomes were measured reliably and appropriate statistical analysis was used.

Table 2.4 Results of Critical Appraisal of Included Quasi-Experimental Studies.

Study	Q1[a]	Q2[b]	Q3[c]	Q4[d]	Q5[e]	Q6[f]	Q7[g]	Q8[h]	Q9[i]
Burland 2013	Y	Y	U	Y	N	Y	Y	Y	Y
Colón-Emeric 2006	Y	U	U	U	N	Y	N	N	U
Hofmann 2003	Y	U	Y	N	N	U	Y	N	U
Nitz 2012	Y	Y	Y	N	Y	Y	Y	Y	Y
Rask 2007	Y	Y	U	Y	Y	Y	N	N	N

Note. Y = Yes, N = No, N/A = Not applicable, U = Unclear.

[a] Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?

[b] Were the participants included in any comparisons similar?

[c] Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?

[d] Was there a control group?

[e] Was there multiple measurements of the outcome/conditions both pre and post the intervention/exposure?

[f] Was follow-up complete, and if not, was follow-up adequately reported and strategies to deal with loss to follow-up employed?

[g] Were the outcomes of participants included in any comparisons measured in the same way?

[h] Were outcomes measured in a reliable way?

[I] Was appropriate statistical analysis used?

2.4.4 Effectiveness of Multiple Level Interventions on Falls Rates

Some studies were not suitable for meta-analysis due to incomplete reporting. Falls rates from five RCTs were pooled for meta-analyses (shown in Figure 2.2). Three studies provided complex intervention at all three levels (Becker et al., 2003; Jensen et al., 2002; Kerse et al., 2004) and two provided interventions delivered at two levels (resident and site) (Dyer et al., 2004; McMurdo et al., 2000). Overall there was no significant between group difference in the rate of falls [RR = -1.29; 95% CI (-3.01, 0.43)]. There was evidence of heterogeneity between the included studies (I^2 = 64%).

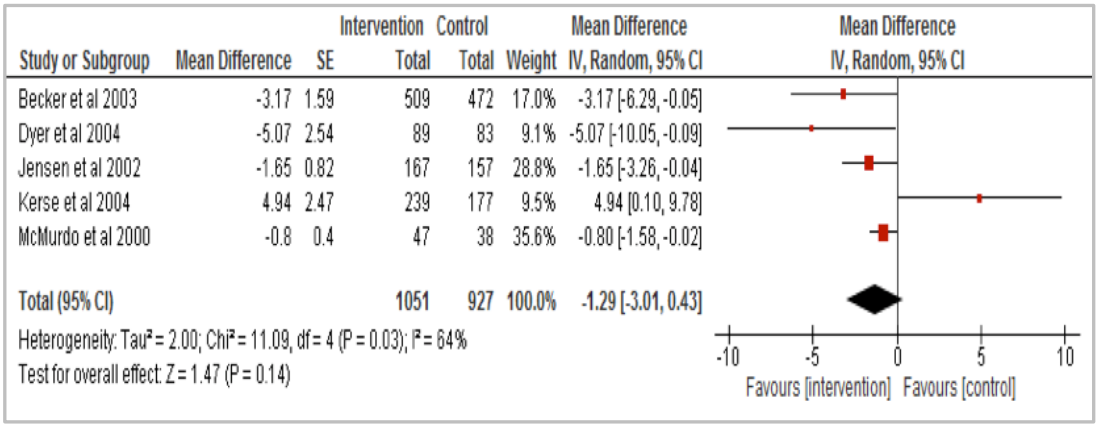

Figure 2.2 Forest Plot of Comparison: Intervention vs Control for Falls Rates.

Sensitivity analysis

For the outcome rate of falls three sensitivity analyses were performed to explore differences in the delivery of the intervention. Three studies (Becker et al., 2003; Dyer et al., 2004; Jensen et al., 2002) which delivered their interventions using notable additional input from external experts and extra resources at three levels were effective in reducing falls rates [RR = -2.26; 95% CI (-3.72, -0.80)] (Figure 2.3).

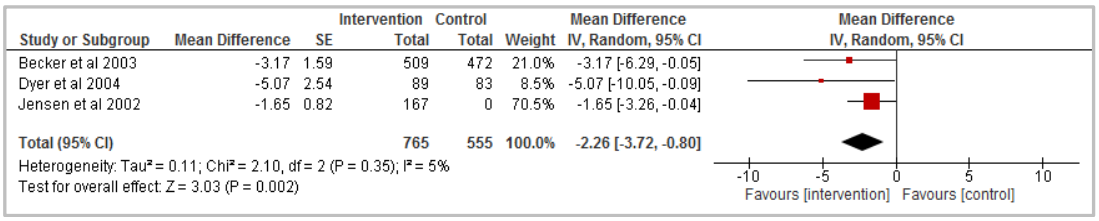

Figure 2.3 Forest Plot of Comparison: Intervention vs Control for Falls Rates in Studies with Additional Resource Support in Intervention Delivery.

The two studies (Kerse et al., 2004; McMurdo et al., 2000) that were removed delivered their multiple level interventions using existing RAC resources with no extra assistance. Removal of these two studies significantly reduced the heterogeneity (I^2 = 5%). Additionally, separate sensitivity analyses were performed, which pooled the studies that delivered interventions at two levels (see Figure 2.4) and those that delivered interventions at three levels (see Figure 2.5). Neither had a significant effect on falls rates [RR = -2.20, 95% CI (-6.13, 1.73)] and [RR = -0.56, 95% CI (-4.02, 2.90)] respectively and heterogeneity was high in both (I^2 = 64% and 75% respectively).

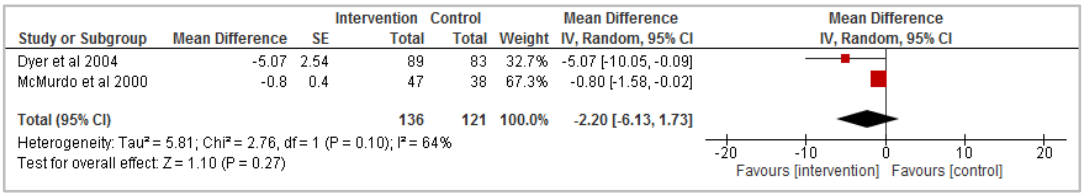

Figure 2.4 Forest Plot of Comparison: Intervention vs Control for Falls Rates in Studies with Interventions Delivered at Two Levels.

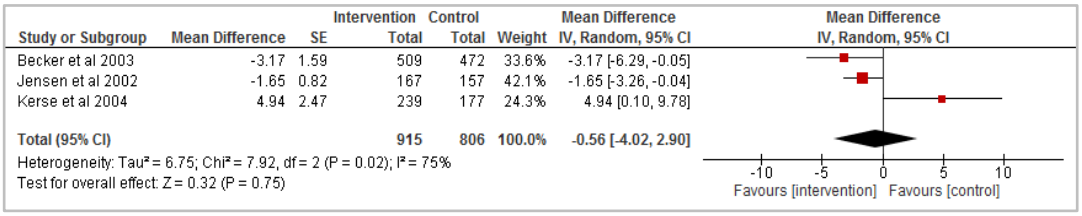

Figure 2.5 Forest Plot of Comparison: Intervention vs Control for Falls Rates in Studies with Interventions Delivered at Three Levels.

Five quasi-experimental studies reported data on falls rates (Burland et al., 2013; Colón-Emeric et al., 2006; Hofmann et al., 2003; Nitz et al., 2012; Rask et al., 2007). Four of the studies (Burland et al., 2013; Colón-Emeric et al., 2006; Nitz et al., 2012; Rask et al., 2007) reported no significant change in falls rates at follow up compared to baseline. One study (Hofmann et al., 2003) reported a significant reduction in the number of falls, however, this study was of low quality and did not report or analyse falls rates according to the global recommendations of the prevention of falls network Europe (Lamb, Jørstad-Stein, Hauer, & Becker, 2005).

Effectiveness of multiple level interventions on fallers

The number of residents who fell (relative to all residents) from five RCTs were pooled for meta-analysis (Becker et al., 2003; Dyer et al., 2004; Jensen et al., 2002; Kerse et al., 2004; McMurdo et al., 2000) (Figure 2.6). Overall there was no significant between group difference in fallers [OR = 0.76, 95% CI (0.42, 1.38)]. There was evidence of high heterogeneity between the included studies (I^2 = 88%).

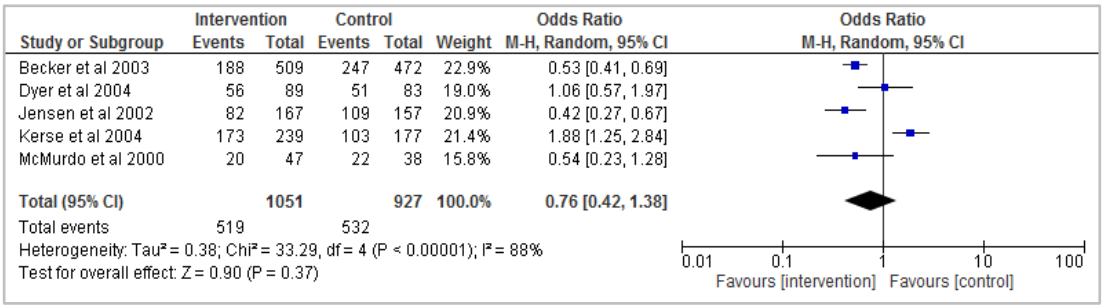

Figure 2.6 Forest Plot of Comparison: Intervention vs Control for the Proportion of Residents Who Fell.

Two quasi-experimental studies reported data on the number of residents who fell (Colón-Emeric et al., 2006; Nitz et al., 2012). One study reported no significant differences in the proportion of residents who fell pre and post intervention (Colón-Emeric et al., 2006). The other study showed a significant reduction in the proportion of fallers (residents who fell once or multiple times) [95% CI (-21.85, -0.28) p = .044] and single fallers (residents who fell only once) [95% CI (-15.03, -0.35) p = .040] (Nitz et al., 2012).

Effectiveness of multiple level interventions on injurious falls rates

Data reporting injurious falls rates from two RCTs were pooled for meta-analyses (see Figure 2.7).

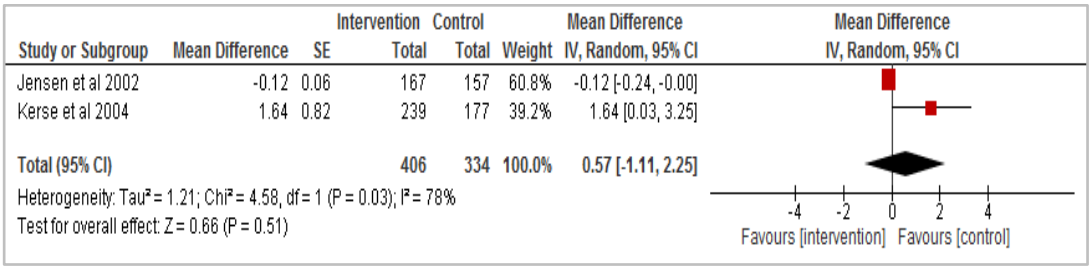

Figure 2.7 Forest Plot of Comparison: Intervention vs Control for Injurious Falls Rates.

These two studies delivered complex interventions at all three levels (Jensen et al., 2002; Kerse et al., 2004). There was no significant between group difference in the rate of injurious falls [RR = 0.57, 95% CI (-1.11, 2.25)] and heterogeneity was high (I^2 = 78%). A further two studies (Ray et al., 2005; Ray et al., 1997) were pooled separately as they classified injurious falls differently, using the prefix 'serious' to include only those injuries from falls that required hospital admission, emergency department or physician visit (see Figure 2.8).

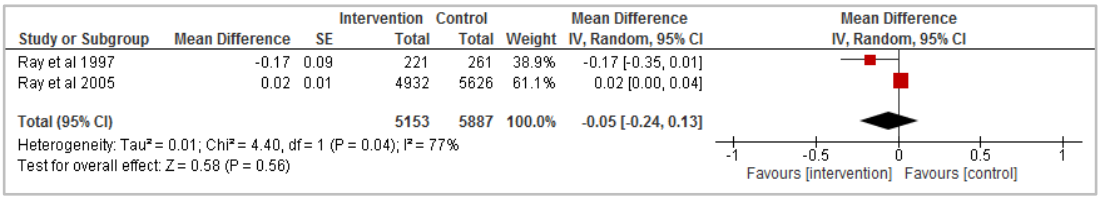

Figure 2.8 Forest Plot of Comparison: Intervention vs Control for Serious Injurious Falls Rates.

These studies both provided interventions delivered at three levels (resident, site and organisation). Again there was no significant between group differences (Figure 2.8) in the rate of serious injurious falls [RR = -0.05, 95% CI (-0.24, 0.13)]. There was also evidence of high heterogeneity in the serious injurious falls rates (I^2 = 77%).

Two quasi-experimental studies reported data on injurious falls (Burland et al., 2013; Hofmann et al., 2003) of which one only reported the number of falls that resulted in fracture (Hofmann et al., 2003). Burland et al. (2013) reported a significant reduction in injurious falls [adjusted RR = 0.79, 95% CI (0.67, 0.96) p = .022]. However this study compared injurious falls rates pre and post intervention between two different groups, meaning results may have been confounded.

2.5 Discussion

Complex interventions using a multiple level approach to prevent falls in RAC settings have been delivered at combinations of resident, site and organisational levels. Synthesised results demonstrated no significant reduction in falls rates or the proportion of residents who fell when intervention delivery targeted combinations of resident, site and organisational levels. High heterogeneity amongst the five included studies was identified and deemed significant. A sensitivity analysis that pooled three studies (Becker et al., 2003; Dyer et al., 2004; Jensen et al., 2002) where interventions were delivered at either two or three levels and supported with additional resources, improved heterogeneity and showed a significant reduction in falls rates. These studies provided additional resources such as extra nursing staff to perform falls risk assessments, personal falls consultation for residents by external staff and extra physiotherapists employed part time during and following the intervention period. This may have enabled better intervention intensity and fidelity without compromise to RAC staff undertaking their usual duties.

Common intervention components provided in these three studies were exercise programs for residents, education for staff and modifications to the environment. Targeting patients (or residents), staff and the environment have previously been identified as domains requiring simultaneous intervention to prevent falls amongst older people in hospital settings (Hill et al., 2015, Haines et al., 2011).

Two meta-analyses (Cusimano, Kwok, & Spadafora, 2008; Vlaeyen et al., 2015) investigating the effectiveness of multifactorial fall prevention programs for older people in RAC showed more favourable results on falls outcomes but did not include the study by Kerse et al. (2004), which we assessed as having low risk of bias, but showed a significant increase in falls outcomes. The meta-analysis of the effectiveness of multifactorial intervention studies by Cameron et al. (2012) included five studies common to ours and showed similar non-significant findings.

The studies included in our review varied widely in terms of the type, intensity and level of the interventions delivered with some differences in setting. For example Becker et al. (2003) provided residents with falls prevention education, hip protectors and balance and resistance exercises twice weekly for 75 minutes, staff received falls education (60 minutes presentation and written material) and monthly feedback on falls outcomes, modifications to the environment that included appropriate lighting chair and bed height and additional safety rails combined with revision of nursing roles to lead falls prevention at their site. In contrast Hofmann et al. (2003) implemented a restorative activity program for residents that was entertainment based, repositioned or removed furnishings within the environment, formed a falls committee and changed staff rostering to cover periods identified as high risk for fall occurrence. Other systematic reviews have also noted that multifactorial interventions vary widely in their components in terms of, the duration, intensity of the intervention and its implementation, which makes interpretation of findings difficult (Cameron et al., 2012; Cusimano et al., 2008; Vlaeyen et al., 2015). Researchers have also suggested that the philosophy of the RAC site, including that of individual staff, may influence whether a falls prevention program is successful (Dyer et al., 2004).

2.5.1 Implications for Practice

Our finding regarding the requirement of additional intervention resources to achieve a significant reduction in falls rates poses a problem in an industry faced with resource constraints. It has previously been suggested that interventions in RAC facilities need to be delivered with existing resources due to the financial constraints of the RAC sector (Kerse, 2010). Peak bodies representing the RAC sector in Australia have recently reported they have serious concerns regarding their ability to provide high quality care because of planned government cuts to RAC funding. Changes to the funding criteria are estimated to cost the sector over $1.6 billion over the next four years (Keast, 2016). So whilst current evidence supports delivery of multifactorial falls prevention interventions to improve falls outcomes, we concur with other researchers in stating that assisting RAC organisations to find a sustainable means of achieving this is of primary importance (Burland et al., 2013; Kerse, 2010; Nitz et al., 2012; Vlaeyen et al., 2015).

2.5.2 Limitations

Only a small number of studies were eligible for meta-analysis and sensitivity analysis therefore the results must be interpreted with caution. We were not able to account for the heterogeneity of resident case-mix and staffing in these RAC settings in our analyses. Consideration should also be given to intervention fidelity and intensity. These complex interventions delivered at multiple levels incorporated a range of different strategies, making it difficult to attribute the beneficial outcomes to individual components or levels. Variations in the methods of gathering, reporting and analysing falls data were also noted. Thus careful descriptions of intervention components, intensity and fidelity and adherence to falls reporting recommendations are required for better comparisons in the future.

2.6 Conclusion

Implementing multifactorial falls prevention programs across multiple levels is challenging in RAC settings. There are limited resources to provide falls prevention interventions for a frail population with complex needs. The best available evidence indicates that multifactorial interventions delivered at resident site and organisation

levels can be effective in reducing falls rates in the RAC population when additional external expertise and resources are provided in the short term.

2.7 Recommendations for Future Research

A strength of this meta-analysis was the inclusion of studies with high methodological quality but this in turn limited the number available for pooling, hence more high quality studies investigating complex multiple level interventions are required. In addition, there is a need to determine how RAC organisations can participate in falls prevention research to facilitate sustainable delivery of evidence-based falls prevention interventions with existing resources. When large research studies using external resources have been conducted it is not known if the positive outcomes reported are sustained in the longer term, as RAC facilities may return to their usual operation conditions when the additional resources are withdrawn. More translational research is required with longer follow up periods to measure ongoing changes.

The present research examined these findings and sought to design an intervention whereby using the existing resource of multidisciplinary RAC staff with an interest in falls prevention, enabled to interact regularly, would deliver multifactorial falls prevention strategies across multiple levels of the RAC organisation. We hypothesised there would be a group of RAC staff with a common interest in working with others on improving falls prevention. Sharing ideas across the organisation and collaborating on problem solving could also offer learning opportunities to raise staff expertise and deliver favourable outcomes. In searching for models to fit these intervention criteria ‘communities of practice’, defined as a group of people with a common interest meeting frequently to share ideas and collaborate, was synonymous with our proposed intervention criteria. CoPs have been used in healthcare to promote evidence-based practice (Tolson, Booth & Lowndes, 2008) and in the setting of a RAC facility to enhance clinical teaching and learning for staff and student nurses (Grealish, Bail & Ranse, 2010). We also considered the requirement that CoPs need their members to meet frequently on an on-going basis to facilitate change but many organisations have recognised that the frequency of face to face meetings necessary to drive change is costly in terms of wasted staff time on travel to and from a meeting place (Dubé, Bourhis &

Jacob, 2006). A web-based environment could enable the formation of a CoP that would otherwise be restricted by time or geographic location (Dubé et al., 2006; Kimball & Ladd, 2004). Some RAC provider organisations have invested in information and communication technologies to benefit staff such as an intranet platform for email exchange, forums, occupational software and access to information databases. Such organisations therefore have the infrastructure capability to support a web-based CoP. In addition an important feature of a CoP was that it could be a sustainable means of delivering evidence-based falls prevention strategies within the resource constrained RAC environment. The methods for this research will be described in detail in Chapter 3.

2.7.1 Research Aims

The purpose of this research was to evaluate the impact of a falls prevention CoP on falls outcomes in a RAC setting.

The specific research aims were:

- **Study 1** (Chapter 4): to describe the development and evaluate the establishment of a web-based CoP to lead falls prevention activity in a RAC organisation; to explore CoP members' capability, confidence, opportunity and motivation to participate in web-based activity using the organisation's intranet and to identify barriers and facilitators for sustainable web-based CoP member participation.
- **Study 2** (Chapter 5): to evaluate if a CoP could conduct a falls prevention activity clinical audit, to determine if a CoP could identify gaps in falls prevention practice and to identify barriers to the adoption of CoP planned falls prevention activities and facilitated actions.
- **Study 3** (Chapter 6): to evaluate the impact of a falls prevention CoP on translating falls prevention evidence into practice.
- **Study 4** (Chapter 7): to investigate the impact of a falls prevention CoP, acting at multiple levels of a RAC organisation on falls rates and injurious falls (resulting in fracture) rates.

2.7.2 Overview of The Research Structure

An overview of the structure of the research, including how each phase of the research contributes to the chapters of the thesis is presented in Figure 2.9.

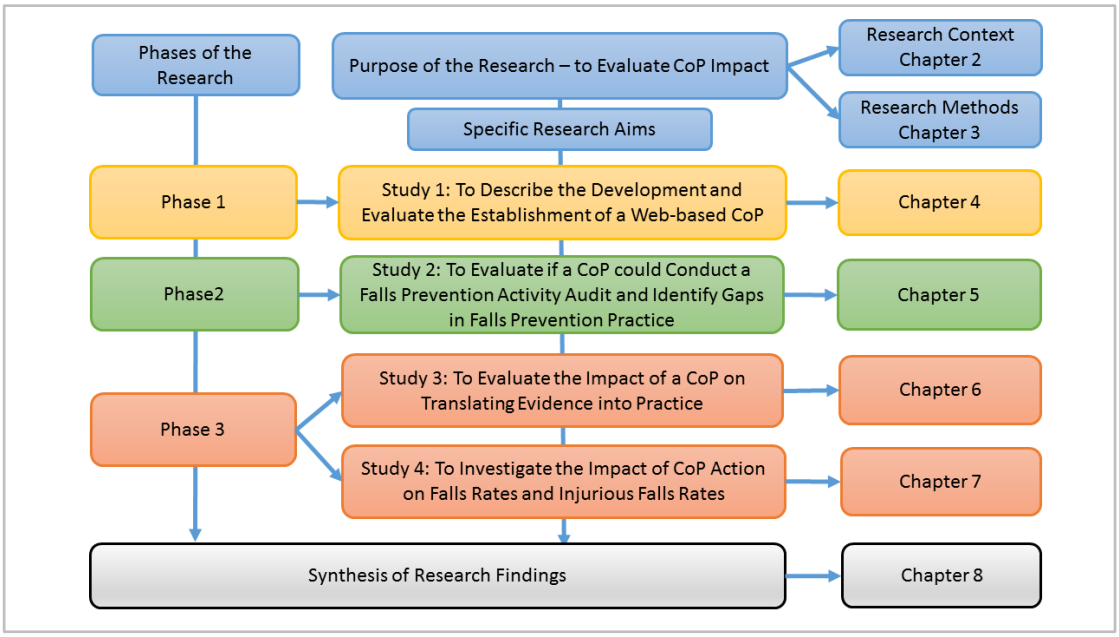

Figure 2.9 Overview of the Research Structure.

2.8 References

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