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Title: What works to prevent falls in older adults dwelling in long term care facilities and hospitals? An umbrella review of meta-analyses of randomised controlled trials

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Highlights

Conflicting evidence exists regarding the effectiveness of exercise and vitamin D supplementation to prevent falls in hospital and LTCF settings

The most promising evidence exists for multifactorial interventions in LTCF and hospitals.

The methodological quality of MA to date is moderate to high quality.

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What works to prevent falls in older adults dwelling in long term care facilities and hospitals? An umbrella review of meta-analyses of randomised controlled trials

Running title: What works to prevent falls?

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Abstract

Preventing falls in long term care facilities (LTCF) and hospitals is an International priority. Many interventions have been investigated and summarised in meta-analyses (MA) and there is a need to synthesise the top of the hierarchy of evidence in one place. Therefore we conducted an umbrella review of MA of randomised controlled trials (RCTs) of falls prevention interventions LTCF and hospitals. Two independent reviewers searched major electronic databases from inception till October 2014 for MA containing ≥ 3 RCTs investigating any intervention to prevent falls in LTCF or hospitals in older adults aged ≥ 60 years. Methodological quality was assessed by the AMSTAR tool and data was narratively synthesised. The methodological quality of the MA was moderate to high across the 10 included MA. Nine MA provided data for LTCF and only 2 considered hospital settings. Only 1 MA defined a fall and 2 reported adverse events (although minor). Consistent evidence suggests that multifactorial interventions reduce falls (including the rate, risk and odds of falling) in LTCF and hospitals. Inconsistent evidence exists for exercise and vitamin D as single interventions in LTCF, whilst no MA has investigated this in hospitals. No evidence exists for hip protectors and medication review on falls in LTCF. In conclusion, multifactorial interventions appear to be the most effective interventions to prevent falls in LTCF and hospital settings. This is not without limitations and more high quality RCTs are needed in hospital settings in particular. Future RCTs and MA should clearly report adverse events.

PROSPERO registration:

http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42014010715

Key words: Falls prevention, older adult, long term care facilities, exercise, vitamin d supplementation, hospitals, umbrella review

Introduction

Falls represent a substantial threat to the ageing global population's quality of life and remain a leading cause of morbidity and mortality [1-3]. Falls are particularly problematic and common in long term care facilities (LTCF) and hospitals [4]. Indeed, the consequences of falling can be particularly devastating in these settings with high rates of injury, reduced quality of life and even death [4]. Hip fractures are of particular concern since of those that experience a hip fracture 1 in 5 will die and less than one third will regain their previous level of functioning [5,6]. The financial costs of falling are also profound. For instance, a recent study demonstrated that the cost of care following a hip fracture is \$40,000 [7]. Given the aforementioned, it is unsurprising that many national and international guidelines have been developed seeking to prevent falls [1,8,9].

In order to prevent falls and these catastrophic consequences, a range of interventions have been developed and tested through robust randomised controlled trials (RCTs) and subsequently summarised in systematic reviews and meta-analyses. Indeed, conclusions based on systematic reviews of RCTs are considered the top of the hierarchy of evidence [10]. Despite the fact that meta-analyses are the cornerstone of evidence based medicine and considered the "gold standard", there is an increasing realisation that even a perfect meta-analysis with perfect data can only provide a partial overview of an intervention available to clinicians [12]. When one considers the complex nature of falls prevention and multitude of interventions available, this notion becomes evidently clear. In addition, there is a rising challenge for busy clinicians to keep on top of the evidence base of any given topic and it is not feasible for clinicians to read multiple individual systematic reviews. Therefore the popularity of umbrella reviews, or systematic reviews of systematic reviews has increased as these seek to provide clinicians, policy makers and researchers the highest quality information in one place regarding any particular intervention. Considering the prevention of falls in LTCF and hospitals, a number of interventions have been considered in systematic reviews to date [4].

Given the aforementioned, we sought to conduct a comprehensive umbrella review of all systematic reviews including meta-analyses of RCTs that sought to prevent falls in older adults dwelling in LTCF of hospital settings.

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Method

This umbrella review followed a predetermined published protocol (PROSPERO registration http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42014010715).

Eligibility criteria

Meta-analyses of RCTs that investigated any intervention that sought to reduce falls in older adults dwelling in LTCF or delivered in hospitals were included. More specifically, meta-analyses had to meet the following criteria:

Population – Older adults (mean age ≥ 60 years and above) dwelling in LTCF or hospitals. Studies conducted in community dwelling older adults were excluded. We also excluded reviews focussing solely on specialist populations (e.g. stroke, Parkinson's disease, dementia) in order to increase homogeneity.

Interventions – Any intervention that sought to prevent falls (including the rate, number, risk or odds of falling).

Outcomes – Our primary outcome was the effect of interventions on the rate of falls and/ or the number of fallers. We defined a fall as 'an unexpected event in which the participants come to rest on the ground, floor, or lower level' [14]. We considered any type of falls, including recurrent (2 $>$ falls over the study period) and injurious falls.

No language restrictions were placed upon the studies we considered. We only considered meta-analyses that were informed by a systematic review of the literature. In addition, we only included meta-analyses when they contained at least 3 RCTs. When a meta-analysis reported multiple subgroup and sensitivity analysis, we report the primary effect size for each intervention. If we encountered meta-analyses that were updates from previous reviews (e.g. updated Cochrane review), we only included the most recent meta-analysis. If we encountered reviews on similar

topics but contained different search strategies, inclusion criteria, analyses and results we included both reviews (decided by three authors). If we encountered meta-analyses including some controlled trials, we included the pooled results but only if RCTs accounted for $\geq 50\%$ of the included studies.

Search procedure

Two independent authors (BS, SB) conducted a systematic search of MEDLINE, EMBASE, CINAHL, AMED, BNI, PsycINFO, Cochrane Library, PubMed and the PEDro databases from inception till October 2014. A third author (MD) was available as a mediator. The key words used in the searches were 'falls' or 'fall*' or 'recurrent falls' or 'injurious fall' or 'fall prevention' AND 'randomised control trial' or 'RCT' or 'systematic review' or 'meta-analysis' AND 'older adult' or 'elderly' or 'age' AND 'intervention' or 'exercise' or 'vitamin d supplementation' or 'multifactorial'. We considered the reference lists of all potentially eligible articles and of a recent umbrella review of falls interventions in community dwelling older adults [13].

Data extraction and synthesis

Two independent authors extracted data from each study (BS, SB) and a third reviewer was available (MD) throughout. The data extracted from each study included: first author, year of publication, country, setting, aim, search strategy, eligibility criteria, type of fall investigating, falls definition used, details of falls intervention, number of studies and number of participants, participant demographics, main results, adverse events, heterogeneity, publication bias and conclusions. Within the literature a number of different statistical approaches have been employed to consider the effectiveness of falls interventions. We did not place any restriction on the type of analyses and considered rate ratios (RaR=rate of falls between the intervention and control groups), risk ratios/ relative risk (RR= compares the number of people who have fallen between the intervention and control group) and odds ratios (OR=odds of having a fall during the trial; [4,15]. Collectively, we refer to the effect of

interventions on 'falls' but when referring to individual meta-analyses we utilise the measurement in that study.

Methodological quality assessment

Two independent authors (BS, SB) completed methodological quality assessment utilising the Assessment of multiple systematic reviews tool (AMSTAR, [17]). The AMSTAR tool consists of 11 items which are rated as 'met', 'unclear' or 'unmet' and scores are given ranging from 0 (low quality) to 11 (highest quality) [17,18]. AMSTAR scores are graded as high (8-11), medium (4-7) and low quality (0-3) [17-19].

Results

Description of search results

Using the search strategy 107 full texts were considered and 97 articles were excluded with reasons (see online supplementary file 1 for list of all excluded studies). Within the final sample, 10 unique meta-analyses were included reporting 26 pooled analyses [4,20-28]. Full details of the search results are presented in figure 1.

Figure 1 here

Description of included meta-analyses

Full details of the included meta-analyses are summarised in table 1. In brief, 9 meta-analyses provided data for falls interventions in LTCF [4,20-23,25-28] and two contained data for fall prevention interventions in hospital settings [4,24]. The meta-analyses contained between 3 [4,21] and 15 [23] individual RCTs and between 561 ([4]; combined exercises) and 11,275 [27] unique participants across the pooled analyses. Only 1 meta-analysis defined a fall [22] and only two provided details of adverse events which were minor [24,27] (see table 1).

Overall, the methodological quality of the included meta-analyses was moderate to high. More specifically four were graded as high quality [4,21,22,25] and six were graded at moderate quality [20,23,24,26-28]. Half of the meta-analyses did not formally assess heterogeneity with a statistical test and details of those that did are summarised in table 1 [20,23-25,28,29].

Interventions in Long Term Care Facilities

Exercise in LTCF

Four meta-analyses investigated a range of exercise interventions in LTCF [4,20,23,26]. From these 3 out of 10 pooled analyses from two meta-analyses [20,26] demonstrated a significant effect on

reducing falls (including the odds, rate and risk of falling). Briefly, Guo et al [20] pooled data from 10 RCTs (n=1,262) investigating a range of exercise interventions and found a significant reduction in the odds of falling in the intervention group (OR 0.79 (0.64-0.98)). However, when two tai chi RCTs were removed the result became non-significant (OR 0.84 (0.63-1.11, N=8, n=917)). Cameron et al [4] found that exercise had no significant effect on reducing the rate of falls across 4 pooled analyses. Sherrington et al [23] pooled data from 15 RCTs (n=unclear) in LTCF and also found that exercise interventions has a non-significant effect. Lastly, Silva et al [26] pooled data from 14 RCTs in the most recent meta-analyses and found that exercise significantly reduced the risk of falling (RR 0.77 (0.64-0.92) n=1,292). Silva et al [26] conducted a subgroup analyses and found that only combined exercises were significantly associated with a reduced in the risk of falls in LTCF (RR 0.71 (0.55-0.90), N=9, n=885, $I^2=72.0\%$).

In summary, inconsistent evidence exists with evidence from 2 from 3 meta-analyses or 3 out of 10 pooled results demonstrating that exercise can reduce falls. Therefore, the benefits of exercise on reducing falls in hospitals and LTCF are not consistently evident in the literature to date. This is based primarily on moderate and high quality evidence.

Vitamin d supplementation in LTCF

Five meta-analyses investigated the influence of vitamin D supplementation on falls [4,20,22,25,28]. This included 6 pooled analyses and only 1 of these demonstrated a significant reduction in the rate of falls [4] (RaR= 0.63 (0.46-0.86) N=5, n=4,603). Of the remainder, one other meta-analyses demonstrated a trend towards significance [22] (RR 0.90 (0.80-1.01), N=5, n=1,428) and two pooling's from another meta-analysis demonstrated a non-significant reduction in the risk of falling from vitamin D supplementation with and without calcium [28]. Given this, the current evidence does not support vitamin D supplementation to reduce falls in LTCF currently. This is based primarily on moderate and high quality evidence.

Other single interventions in LTCF

In a large meta-analysis, Santesso et al [27] found that hip protectors were not effective in reducing the rate of falls among older adults dwelling in LTCF (RaR 1.02 (0.90-1.16), N=16, n=11,275, $I^2=92\%$). Guo et al [20] investigated the influence of nutritional supplements on the odds of falling and found it has no significant effect (OR 0.93 (0.77-1.13), N=6, n=4,934). Finally, Cameron et al [4] found no evidence to suggest that implementing a medication review reduces the rate of falls in older adults dwelling in LTCF (RR 1.00 (0.91-1.10), N=4, n=4,857, $I^2=47\%$).

Multifactorial Interventions in LTCF

Two meta-analyses [4,21] investigated the influence of multifactorial interventions on falls, which involves individually tailoring two or more interventions to an individual following a risk assessment. Both meta-analyses produced one result demonstrating that multifactorial interventions reduce falls and overall 2 from 4 pooled analyses demonstrated a significant effect on reducing falls. Specifically, Choi and Hector [21] pooled data from 3 RCTs and found a large significant reduction in the risk of falls (RR 0.45(0.38-0.53), n=1,291, Cochran Q $p<0.001$). Cameron et al [4] investigated multifactorial interventions in greater depth and in their subgroup analyses demonstrated that these were only effective when conducted in intermediate LTCF settings (RaR 0.64 (0.50-0.83), N=3, n=670, $I^2=33\%$). Both of these meta-analyses were classified as high quality according to the AMSTAR. In summary, although sparse, there is evidence to suggest that multifactorial interventions are effective in reducing falls in LTCF.

A summary of the interventions to prevent falls in LTCF are presented in table 2.

Interventions in hospitals

There is consistent evidence from two meta-analyses [4,24] that multifactorial interventions significantly reduce risk and rate of falling in hospitals. Specifically, Cameron et al [4] found from 4 RCTs involving 6,478 people that the rate of falling was significantly reduced (RaR 0.69 (0.49-0.96), $I^2=59\%$). Coussement et al [24] established that individually tailored multifactorial interventions reduced the risk of falls (RR 0.74 (0.58–0.96), N=4, n=3,514). However, when the authors combined

the multifactorial RCTs with single interventions, they found no significant effect on the risk of falls (RR 0.87 (0.70–1.08), N=7, n=3,894). Thus, although sparse, there is evidence that multifactorial interventions are effective in reducing falls (both the rate and risk) in hospital settings. This is based upon moderate and high quality evidence.

Table 1 here

Table 2 here

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Discussion

To our knowledge, this is the first attempt to identify, appraise and summarise the highest tier of evidence of falls prevention interventions in LTCF and hospitals. There is conflicting and limited evidence for most of the interventions to date, although the optimal and most consistent evidence to prevent falls in both LTCF and hospitals are multifactorial interventions. In both of these settings there was moderate/ high quality meta-analyses demonstrating that multifactorial interventions are effective in reducing falls, but the results were limited to only 2 MA's. Surprisingly, only 1 of the included meta-analyses defined a fall within our umbrella review. Moreover, only two meta-analyses reported adverse events arising from the interventions which is concerning given as this information is equally important to policy makers and clinicians to an interventions effectiveness. However, from the two meta-analyses that did report adverse events they were minor and this lack of reporting could represent inadequate reporting in the original RCTs.

From this umbrella review, it is possible to recommend multifactorial interventions as the optimal method to prevent falls in LTCF and hospitals, although the evidence base is still limited. No clear and consistent evidence exists regarding exercise or vitamin d supplementation. This is in contrast to another recent umbrella review on falls interventions in community dwelling older adults which found consistent evidence that exercise was effective as a single intervention with 13 out of 14 pooled analyses demonstrating a positive effect [13]. However, whilst the evidence is equivocal regarding exercise in LTCF, the most recent meta-analyses [26] found that exercise is effective in reducing falls in LTCF and that it is most effective when applied for more than 6 months with a frequency of 2-3 times a week [26]. Thus, in the case of exercise this inconsistency in results from meta-analyses may be due to the fact that the quality of research has only improved recently and thus higher weighting should be given to the findings from Silva et al [26] since they appear to have addressed uncertainties in previous meta-analyses (e.g. [4,23]). The same cannot be said for vitamin

d supplementation as the meta-analyses results have broadly been consistent across all 5 that we included. However, whilst uncertainty exists and vitamin d supplementation is not without controversy within the literature (e.g. [28,30]) several of these demonstrated non-significant reduction in falls. For instance, Kalyani et al [22] and Bolland et al [28] found results of RR 0.90 (0.80-1.01), OR 0.87 (0.71-1.07) and RR 0.92 (0.82-1.02) for vitamin D supplementation respectively. Thus, vitamin D supplementation may prove useful in LTCF to prevent falls, but in its own right cannot be recommend as a primary intervention. We also found no meta-analyses pooling RCTs on exercise and vitamin D supplementation specifically in hospital settings.

The comparative lack of research investigating falls prevention strategies in LTCF and hospitals is clearly not proportionate to the heightened risk and consequences of falls in these settings [31,32]. Surprisingly, despite falls being a considerable issue in hospitals [31,32] we only identified two systematic reviews with a meta-analysis of RCTs investigating the effect of interventions to prevent falls. Clearly the dearth in high quality evidence is concerning given the great need. However, the available evidence is encouraging demonstrating that multifactorial interventions that include individual risk assessment and tailored interventions are effective in preventing falls in these settings. Whilst there is a paucity of research investigating fall interventions in LTCF and hospitals, one comfort is that the quality of the included meta-analyses was moderate and high quality and overall it is higher than in the other umbrella review [13].

Limitations and strengths

Our umbrella review has a number of strengths. We conducted a comprehensive search including only the highest quality evidence (meta-analyses of RCTs) and condensed this in one place to make this readily accessible for clinicians. Another strength is that the methodological quality of the included meta-analyses was moderate and high. Whilst this is the first umbrella review of its kind in LTCF and hospitals, a number of limitations should be acknowledged which are largely reflected by limitations in the original studies and paucity of data. First, there was a relative small number of

eligible meta-analyses, particularly in hospital settings, although ironically we found the most promising and consistent evidence. Second, not all of the studies assessed heterogeneity and as can be seen from table 1, among those that did heterogeneity was present in a number of pooled analyses. Third, the included studies often analysed the effect of interventions using different summary measures (e.g. RaR, RR, OR). Fourth, often the individual meta-analyses did not publish specific details regarding the included studies. Thus, it was not always possible to determine clinical homogeneity. Fifth, several meta-analyses may have included similar studies in their analyses and there may have been some overlap. Also, it is unclear if the lack of adverse events reported in the included meta-analyses is due to the absence of these in the original studies. In addition, relying upon systematic reviews may mean that landmark primary studies are not highlighted. Finally, we could not include several reviews that investigated falls prevention interventions with meta-analysis in mixed settings that did not provide subgroup analysis for older adults in LTCF or hospital settings.

Nevertheless, allowing for these caveats our umbrella review is a first and provides key evidence from the highest tier of the evidence hierarchy for falls prevention in LTCF and hospitals. Whilst the evidence regarding the most effective interventions beyond multifactorial programs are equivocal, it is evidently clear that future systematic reviews must carefully consider and document adverse events reported in any of the included RCTs they include. Although this important outcome is likely limited by the primary studies, policies are often made based upon systematic reviews of interventions. Therefore, it is important that authors of interventions adequately report any harmful side effects and clearly define their outcome measures in advance.

In conclusion, although sparse, some promising evidence to prevent falls in LTCF and hospitals lies with multifactorial interventions. Currently, it is not possible to make any further recommendations beyond that with regard to single interventions such as exercise at the level of meta-analyses of RCTs. There is a need for future RCTs and indeed meta-analyses to carefully record adverse events to inform policy and clinical practice.

Conflict of interest

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Conflict of Interest Disclosures:

None to declare from any author

Author Contributions:

All authors designed the study which was prospectively registered. All authors agree with the final version and submission of the manuscript.

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All authors helped acquire the data, BS, DD, MD wrote the manuscript and SB provided input. All authors have approved the final version.

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Figure 1. PRISMA (2009) flow diagram for search strategy

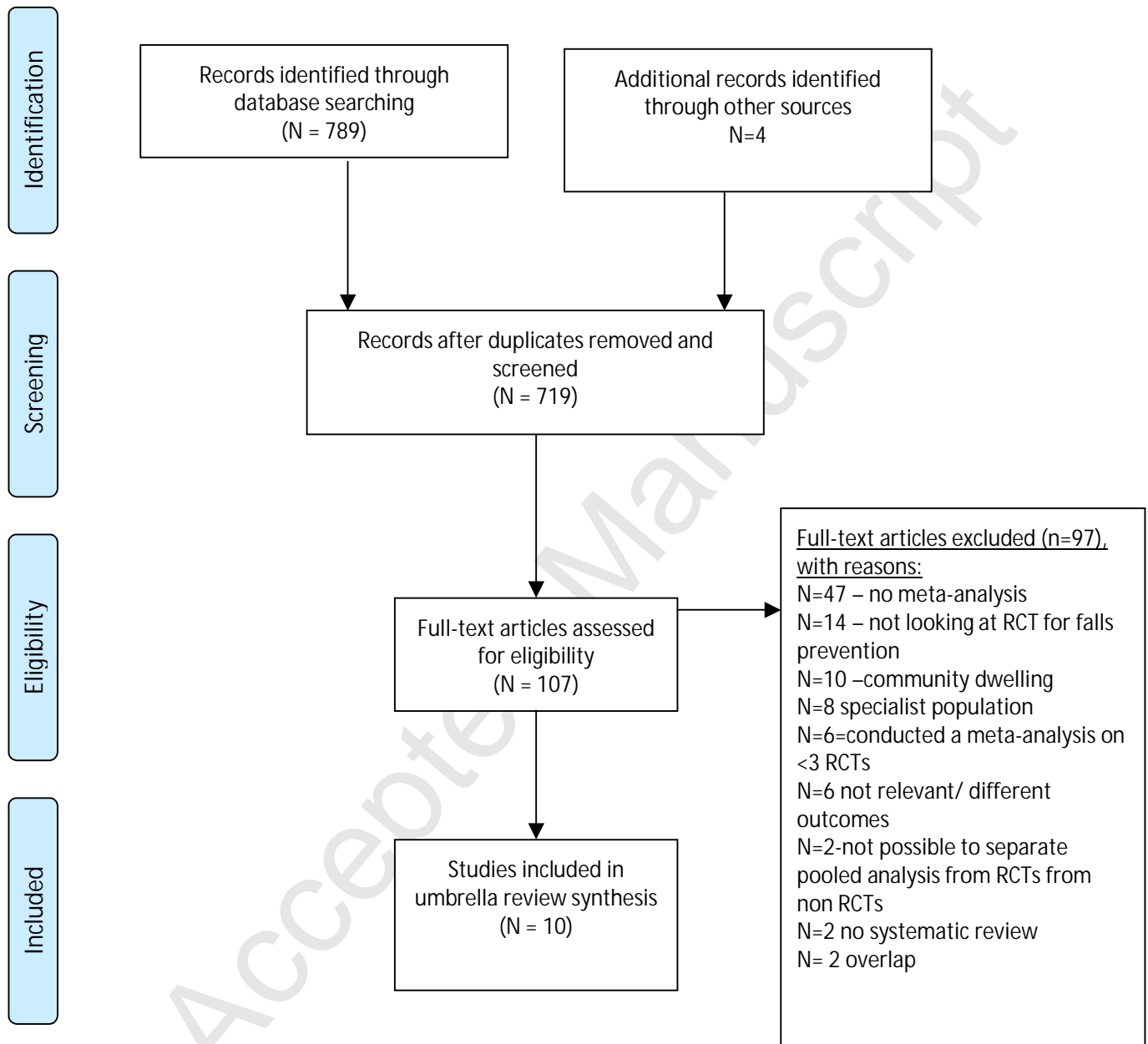


Table 1 - Summary of included studies

Author (Ref)	Country	Intervention and control	RCTs included (n= participants)	Participants details and setting	Define a fall?	Main results (95% CI)	Heterogeneity	Adverse events	AMSTAR	Conclusion
Gou et al 2013 (20)	Tai	Exercise v control Non tai chi exercise Nutritional supplement v control Vitamin D v control Control groups received TAU or another intervention	10 (n=1262) 8 (n=917) 6 (n=4934) 4 (n=4609)	Older adults without cognitive impairment Mean age 64.5 to 89.0. LTCF	No	<u>OR 0.79 (0.64-0.98)</u> OR 0.84 (0.63-1.11) OR 0.93 (0.77-1.13) OR 0.98(0.79-1.22)	NR	NR	4	Exercise reduces falls in older adults in LTCF. Pooled effect become non-significant when exclude 2 X tai chi results from analysis Nutritional supplements and Vitamin D have no significant effect on falls.
Choi & Hector 2012 (21)	US	Multifactorial interventions	3 (n=1291)	Mean age 79.2 years LTCF	No	<u>RR 0.45(0.38-0.53)</u>	Q=62.7, P <.0001	NR	8	Multifactorial interventions reduce falls in LTCF.
Cameron et al 2012 (4)	AUS	<u>Exercise Care facilities:</u> High level care Intermediate care Combination exercises <u>Medication review Care facilities</u>	8 (n=1844) 4 (n=625) 4 (n=1219) 4 (n=561) 4 (n=4857)	Care facilities 84 years & 77% women Hospitals 79 years 58% women	No	RaR 1.03 (0.81-1.31) RaR 1.29 (0.93-1.79) RaR 0.80 (0.57-1.13) RaR 1.24 (0.84-1.83) RR 1.00 (0.91-1.10)	I ² =70% I ² =64% I ² =60% I ² =73% I ² =47%	NR	10	<u>LT Care facilities:</u> Exercise does not reduce falls as a single intervention (including when separated into high and intermediate care). Medication chart review does not reduce falls.

		<u>Vitamin D Care Facilities</u>	5 (n=4603)			<u>RaR 0.63 (0.46-0.86)</u>	I2 =72%			Vitamin D supplementation does significantly reduce falls. Multifactorial interventions only reduce falls in intermediate care but not high level care settings. <u>Hospital settings:</u> Multifactorial interventions significantly reduce falls in hospital settings.
		<u>Multifactorial interventions Care facilities:</u>	7 (n=2876)			RaR 0.78 (0.59-1.04)	I2 =84%			
		High level care	4 (n=2206)			RaR 0.88 (0.59-1.29)	I2 =86%			
		Intermediate care	3 (n=670)			<u>RaR 0.64 (0.50-0.83)</u>	I2 =33%			
		<u>Hospitals Multifactorial interventions</u>	4 (n=6478)			<u>RaR 0.69 (0.49-0.96)</u>	I2 =59%			
Kalyani et al 2010 (22)	US	Vitamin D	5 (n=1428)	80 years and above in hospitals or LTCF	Yes	RR 0.90 (0.80–1.01)	I2 =0%	NR	9	There was a trend for vitamin D to reduce falls in hospitals and LTCF, but this was not significant.
Sherrington et al 2011 (23)	Aus	Exercise	15 (n=?)	Residential care, LTCF. Demographics not available.	No	RaR 0.93 (0.78–1.11)	NR	NR	5	Exercise did not reduce falls in LTCF residents.
Coussemont et al 2008 (24)	Bel	Hospital fall prevention programs	7 (n=3894)	69-85 years	No	RR 0.87 (0.70–1.08)	NR	4/8 RCTs reporter adverse events. All minor.	6	Pooling single and multifactorial interventions together had no significant effect on falls. Multifactorial falls interventions may reduce falls, but when this analysis
		Single interventions	3 (n=380)	Hospitals.		No pooled data				
		Multifactorial Interventions	4 (n=3514)			<u>RR 0.74 (0.58–0.96)</u>				

		Note-2 were CCT, not RCTs.								was adjusted for clustering it was no longer significant.
Murad et al 2011 (25)	US	Vitamin D	10 (n=?, overall sample)	76 years, 78% female LTCF.	No	OR 0.87 (0.71–1.07)	NR	NR	8	Vitamin D does not reduce falls in people in institutions.
Silva et al 2013 (26)	Aus	Exercise pooled analysis	14 (n=1292) (9 RCTs combined exercise & 5 RCTs single)	68% female, 83.9 years LTCF	No	RR 0.77 (0.64-0.92)	I2=72.1%	NR	5	Exercise is effective in reducing falls in LTCF. It is most effective when combination of exercises are used.
		Combined exercise interventions	9 (n=885)			RR 0.71 (0.55-0.90)	I2=72.0%			
		Single exercise interventions	5 (n=498)			RR 0.86 (0.65-1.14)				
Santesso et al 2014 (27)	Can	Hip protectors	16 (n=11275) Unclear how many RCTs were LTCF ? 14	65+years LTCF.	No	RaR 1.02 (0.90-1.16)	I2= 92%	5% experience skin irritation	7	Hip protectors have no significant effect on falls in LTCF.
Bolland et al 2014 (28)	NZ	Vitamin D with (N=1) or without calcium (N=5)	6 (n=2013)	Mean age 83 to 89 years in RCTs, 73-100% females in RCTs	No	RR 0.96 (0.88–1.05)	NR	NR	6	Vitamin D has no significant effect on falls in a traditional meta-analysis approach.
		Vitamin D no calcium	5 (n=1430)	LTCF.		RR 0.92 (0.82–1.02)	NR			

Key = NR= not reported, OR = odds ratio, CI= confidence interval, RR= risk ratio, RaR=rate ratio (rate of falls), LTCF = long term care facilities, RCT = randomised control trial, N= new Zealand, Can=Canada, US = United States, Aus= Australia, Bel=Belgium, Tai=Taiwan,

Table 2 – Summary overview of findings of meta-analysis reporting the falls prevention interventions in LTCF and hospital settings

Intervention	Number of MA's	Number of pooled analysis	Number of MA's (pooled analysis in brackets) [references]			Overall effect % (pooled)*	Comment
			Reduces falls	Increases falls	Non - significant effect		
<u>Single interventions</u>							
<u>LTCF</u>							
Exercise	4	10	2 (3) [20, 26]		4 (7) [20, 23]	+30% (3/10)	Inconsistent evidence exists regarding the influence of exercise on falls.
Vitamin D	5	6	1 (1) [4]		4 (5) [20, 22, 25, 28]	16.6% (1/6)	Vitamin D does not consistently reduce falls. Combining with calcium does not appear to have alter the effect.
Nutritional supplements	1	1			1 (1) [20]	No evidence	1 MA demonstrated that nutritional supplements do not reduce falls
Medication review	1	1			1 (1) [4]	No evidence	1 MA demonstrated that medication review has no significant effect on falls
Hip protectors	1	1			1 (1) [27]	No evidence	1 MA demonstrated hip protectors do not reduce falls
<u>Multifactorial, combined and multicomponent interventions</u>							
<u>LTCF</u>							
Multifactorial interventions	2	4	2 (2) [4, 21]		1 (2) [4]	50% (2/4)	Multifactorial interventions may reduce falls in LTCF, this appears most promising in intermediate care settings.
<u>Hospital</u>							
Multifactorial interventions	2	2	2 (2) [4, 24]			100% (2/2)	Multifactorial interventions reduce falls in hospital settings. However, one MA result was not significant when adjusted for clustering.
Single & Multifactorial combined	1	1			1 (1) [24]	0% (0/1)	One MA showed that pooling single and multifactorial interventions had no significant effect on falls. However, separated in subgroup analyses multifactorial interventions reduced falls.

Key = MA=Meta-Analysis, *Overall effect = number of supporting associations versus overall number (pooled), LTCF = long term care facilities,