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The effect of eHealth-based falls prevention programmes on balance in people aged 65 years and over living in the community: protocol for a systematic review of randomised controlled trials

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ABSTRACT

Introduction Between 20% and 28% of community-dwelling older people experience a fall each year. Falls can result in significant personal and socioeconomic costs, and are the leading cause of admission to hospital for an older person in Australia. Exercise interventions that target balance are the most effective for preventing falls in community-dwellers; however, greater accessibility of effective programmes is needed. As technology has become more accessible, its use as a tool for supporting and promoting health and well-being of individuals has been explored. Little is known about the effectiveness of eHealth technologies to deliver fall prevention interventions. This protocol describes a systematic review with meta-analysis that aims to evaluate the effect of eHealth fall prevention interventions compared with usual care control on balance in people aged 65 years and older living in the community.

Methods and analysis We will perform a systematic search of the following electronic databases: MEDLINE, CINAHL Complete, Embase and PsychINFO and citation search of Scopus, Web of Science, PubMed Central, Cochrane Database Central and PEDro for randomised controlled trials that use an eHealth technology to deliver a fall prevention intervention to community-dwellers aged ≥65 years, that are published in English, and include a balance outcome (primary outcome). The screening and selection of articles for review will be undertaken by two independent reviewers. The PEDro scale and Grading of Recommendations, Assessment, Development and Evaluations will be used to assess study quality. The results will be synthesised descriptively, and if sufficient data are available and the studies are not overly heterogeneous, a meta-analysis will be conducted using the random effects model.

Ethics and dissemination As this will be a systematic review, without involvement of human participants, there will be no requirement for ethical approval. The results of this systematic review will be disseminated through peer-reviewed publications, conference presentations and dissemination to policymakers and consumers to maximise health impact.

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Strengths and limitations of this study

► This systematic review protocol has been developed with reference to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.
► This systematic review will undertake a bibliographic search of the electronic databases MEDLINE, CINAHL Complete, Embase and PsychINFO.
► A citation search of Scopus, Web of Science, PubMed Central, Cochrane Database Central and PEDro will also be conducted.
► To locate potential studies the selection of studies will follow a three-stage process of exclusion, screening and final selection.
► The PEDro Scale and Grading of Recommendations, Assessment, Development and Evaluations will be used to assess study methodological quality.

INTRODUCTION

Falls in older age are a serious and complex health concern. Studies have found between 20% and 28%[1–3] of community-dwelling people aged ≥65 years experience at least one fall each year. Falls are the main cause of unintentional injury and a leading cause of morbidity and mortality in older people.[4 5] Falls are the leading cause of injury-related hospitalisation among older people, and account for 40% of all injury-related deaths.[6]

Compounding this is population ageing. Globally, countries are experiencing rapid growth in the number and proportion of older people.[7] It is estimated, the number of people aged ≥60 years will double to 2.1 billion people by 2050, and triple to 3.1 billion by 2100.[7] Given the incidence of hospital admissions exponentially increases with age, it is expected health and social costs associated with falls will increase. A systematic review of

international studies found fall-related costs were between 0.85% and 1.5% of the total healthcare expenditure, or 0.07%–0.20% of the gross domestic product for developed countries[8] such as the United States of America, Australia, Europe and the UK.

Falls also result in significant hidden costs. Componding the direct medical costs associated with falling are the fear of falling, pain, decreased well-being and functional capacity, feelings of helplessness and confusion, a loss of independence, depression, social isolation and loneliness, poor health, admission to a care facility and death[4] compound the direct medical costs associated with falling. Falls also have a negative impact on families and carers, contributing to societal productivity losses such as work-related absenteeism and lost income.[4]

The research into fall prevention is extensive. While research has identified several effective interventions (ie, multifactorial and multiple component interventions) to be effective at preventing falls and injurious falls in community-dwelling older people,[9] it has firmly established exercise as a single intervention that prevents falls in community-dwelling older people.[6 10 11] Sherrington *et al*[11] found the most effective fall prevention programmes focus on improving balance through the prescription of exercises that provide a moderate-to-high challenging to balance, and consist of 3 or more hours per week of exercise.

The advances in technology which have made the internet highly accessible and more usable have also given rise to the popularity of internet mobile services (such as smartphones, applications (apps)), exergaming and social media.[9] This has resulted in internet-enabled activities to become embedded in mainstream society.[9] Realising the benefits of eHealth technologies to deliver low-cost health interventions, as well as their popularity among consumers for tracking health and physical activity, researchers have begun to use technology as a way to improve the health and well-being of individuals. Systematic reviews have found internet-delivered physical activity interventions can significantly improve physical activity[12] and physical function[13] of older people.

eHealth is the term used to describe the uses of information and communication technology, healthcare and health promotion-focused web-driven applications such as telemedicine, electronic health records, virtual interventions and personal health monitoring systems to deliver treatment, information and interventions designed to improve health.[14]

While researchers have begun to explore the use of technology in health interventions, little is known about the effectiveness of eHealth technologies to fall prevention programmes.[9] Given the rapid developments in this area, and the potential of an eHealth technology to allow participants the flexibility to practice their balance exercise from home or another location, the appeal of eHealth-delivered fall interventions is considerable. This protocol describes a systematic review with meta-analysis that aims to evaluate the effect of eHealth-delivered fall prevention interventions compared with usual care control on balance in people aged 65 years and older living in the community.

METHODS AND ANALYSIS

This systematic review protocol has been developed with reference to the PRISMA guidelines. This protocol was compiled by MA and reviewed by all authors. This protocol has been registered in the PROSPERO database.

Eligibility criteria

Studies will be included in this systematic review if they meet the following criteria: (1) published in English, (2) randomised controlled trial (RCT), (3) participants are community-dwelling people aged ≥65 years, (4) report data for a validated measure of balance, (5) include eHealth delivery of a fall prevention intervention compared with no intervention, usual care or wait-list control. Studies that do not meet these criteria will be excluded.

We will include all RCT designs such as crossover, cluster, patient-randomised clinical trials that examine the effect of eHealth-delivered fall prevention programmes. Single and multifactorial interventions will be included. Studies published only as abstracts or yet to be published will be excluded due to possible data inaccuracy and incompleteness.

Search strategy

The following bibliographic electronic databases will be searched from inception up to September 2019: MEDLINE, CINAHL Complete, Embase and PsychINFO. A citation search will also be conducted in Scopus, Web of Science, PubMed Central, Cochrane Database Central and PEDro. Forward citation searching for all included trials will be conducted. Experts in the field will be contacted via email to identify relevant trials. Finally, reference lists of included trials and key studies identified through the search will also be manually searched for potential studies not identified.

To locate potential studies a predetermined search strategy will be used (see Table 1). All references, including duplicates, will be imported into the bibliographic software EndNote.

A comprehensive and systematic search will be undertaken to identify all possible studies for inclusion (see figure 1). The draft literature search for the main database (MEDLINE) will be peer reviewed by an experienced research librarian.

Two reviewers (MA, KLA/RS), experienced in the conduct of systematic reviews, will independently screen potential papers for inclusion using an electronic screening form in two stages: screening of titles and abstracts, and screening of full-text articles using the eligibility criteria. Disagreements regarding the eligibility of studies will be resolved through discussion, and when necessary with the help of a third reviewer.

Table 1 A draft literature search for MEDLINE (the key words search string)

MEDLINE search strategy	
Population	(senior* OR elderly OR aged OR old OR age OR 'older adult' OR older OR 65 years)
Intervention	(technology OR telemedicine OR telehealth OR 'communication technology' OR ICT OR 'electronic health' OR eHealth OR internet OR online OR tablet OR ipad OR web OR 'world wide web' OR email OR website OR 'web-based' OR 'website delivered' OR PDA OR 'mobile health' OR mHealth OR 'mobile phone' OR 'short messaging service' OR 'multimedia messaging service' OR SMS OR 'multimedia messaging service' OR MMS OR 'text message' OR app OR smartphone OR 'cell phone' OR 'cellular phone' or 'picture message' OR tracker OR wearable* OR 'digital health' OR 'Information technology' OR fitbit OR garmin OR jawbone OR fuelband OR pedometer OR 'step counter' OR sensors OR exergame* OR nintendo OR wiifit OR wii-fit OR wii fit)
Setting	(community dwelling OR community-dwelling OR community dweller* OR community-dweller*)
Outcome	(accidental falls OR falls OR faller OR fall* OR tripping OR balance OR mobility)

Study authors will be contacted to provide further information if the full text does not provide the information necessary to determine eligibility and inclusion in the review.

The educational backgrounds of the team members examining the papers and involved in the selection process are as follows: MA is a PhD candidate with a master of public health; KLA is an experienced research assistant and honours student with a bachelor's degree in psychology; and RS is an experienced research assistant and is undertaking a bachelor of psychology. The remaining authors (CV, AT, SA and KD) are experienced researchers with backgrounds in public health, exercise science and physiotherapy.

Data items

The primary outcome measure will be balance; therefore, we will include studies that use a validated measure of balance. We will prioritise the extraction of data for clinical balance measures (eg, Berg Balance Scale,[15] single leg stance,[16] Short Performance Physical Battery[17] and others) since they are easier to interpret as they relate to functional activities. Direct measures of balance, such as those measured with a force platform, will be included in the absence of a functional balance measure.

Balance has been selected as the primary outcome measure due to its strong association with falls. Balance is a strong risk factor for falls and has been used as a proxy measure of the possible impact of an intervention on
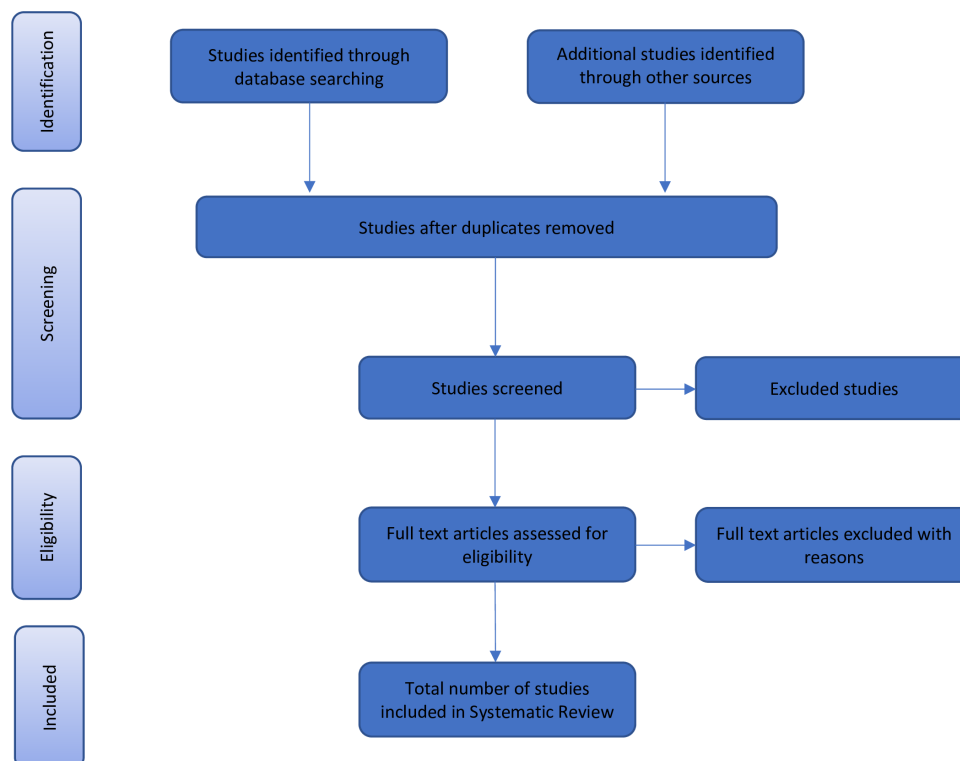

Figure 1 Systematic review search strategy and data collection strategy—see attached PDF file.

Table 2	Data extraction variables
Variables to be extracted	
Study design	
Primary outcome	Static balance, dynamic balance, functional balance
Secondary outcomes	Falls risk, falls rate, fear of falling
Study quality	PEDro score
Sample size	Report sample size
Additional behaviours	No/Yes Report behaviour
Intervention duration	Report duration
Delivery methods	Web-based only, web-based and print, web-based and email, internet and other technology, applications, trackers
Use of technology	How it is used in the intervention (ie, partial or fully tech-based)
Comparison group	Intervention group, minimal intervention, usual care, control group
Intervention attrition	Proportion of participants who completed the intervention
Follow-up period	Report follow-up period
Participant characteristics	
Age	Mean (SD) or age range of included participants
Gender	Female/male
Health status	Healthy, chronic disease (report disease)
Falls history (12 months)	Not screened for, ≤1,≤2,≤3, 3+
Physical activity level	Not screened for, inactive
Recruitment source	
Intervention features	
Intervention dose	Report number of intervention contacts
Single intervention	Exercises—strength; balance; endurance training; flexibility exercises; walking training/practice; medication (targeted to a drug—withdrawal, reduction, increase, substitution, provision); surgery; psychological interventions; environment/assistive technology; educational (interventions to increase knowledge); adherence
Multiple interventions	Yes/No Report interventions tested
Multifactorial interventions	Yes/no Report interventions tested
Supervised	Yes/no If yes, by whom?
Tailored	Comprehensive tailoring; limited tailoring; no tailoring; tailored in intensity or dose or exercise; tailored in type
Behaviour change theory	The behaviour change technique taxonomy (Michie et al., 2013)
Self-Monitoring	Yes/no
Email reminders	Yes/no
Goal setting	
Quizzes	Yes/no
Updated content	Yes/no
Asynchronous communication	Yes/no
Other data	
Author(s), country of study, type of trial/model used, publication year, recommendations, intervention adherence and acceptability, adverse events, other results	

PEDro, Physiotherapy Evidence Database.

falls in circumstances where resources do not allow for the conduct of an adequately powered trial (which would require approximately 500 participants), with falls as the primary outcome. Functional measures of balance are valid predictors of falls.[18 19] We will also extract measures of fall rate, fall risk, fear of falling where they are included in studies as secondary outcomes.

Data on study characteristics such as author(s), country of study, publication year, sample size, setting, intervention(s), comparator, participant characteristics (mean participant age, comorbidities), intervention features (single/multiple intervention, supervised, tailored), intervention adherence and acceptability, and adverse events will be extracted. Table 2 provides a list of the data that will be extracted from the selected studies.

Risk of bias appraisal

The PEDro scale will be used to assess the methodological quality of the included trials. The PEDro scale analyses the internal validity of RCTs via an 11-item YES/NO response, and awards one point towards a study's total PEDro score for each item that is clearly satisfied.[20] Scoring ranges from 0 to 10, with items 2–11 contributing one point towards the total PEDro score.[20] Scale item 1 is exempt from a score as it concerns external validity.[20] A score of 10 is considered excellent, whereas 0 demonstrates poor methodological quality.[20 21] The criteria assessed by the PEDro scale are: (1) specified participant eligibility criteria, (2) random allocation, (3) concealed allocation, (4) homogeneity of groups at baseline, (5) blinding of subjects, (6) blinding of therapist, (7) blinding of assessor, (8) follow-up of subject (at least 85%), (9) intention to treat analysis, (10) group statistical analysis, and (11) provide variability and point measures.[21]

Assessment of quality of evidence

We will use the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) system to assess overall quality of the evidence. The GRADE system is a subjective evaluation of the quality of the evidence as high, moderate, low or very low based on the presence or extent of five factors: risk of bias, imprecision, inconsistency of the effect, indirectness and publication bias.[22]

Statistical analysis

The results will first be synthesised descriptively, reporting study characteristics, patient characteristics, risk of bias and frequency of outcomes across the included RCTs. For each included trial, we will calculate treatment effects measured by continuous variables using mean differences (Hedges' g) standardised by post-score standard deviation (or its estimate) with 95% CI, for either between-group differences in point estimates at the follow-up time points or between-group differences in change scores, according to available data. Effect sizes will be categorised as small (0.2), medium (0.5) or large (0.8 or greater).[23] Treatment effects measured by dichotomous variables will be assessed using risk ratios and 95% CIs.

If sufficient data are available and the studies are not overly heterogeneous, a meta-analysis will be conducted using the random effects model using comprehensive meta-Analysis software (V.3, Biostat). Statistical heterogeneity will be determined by visual inspection of the forest plots and with consideration of the I^2 and χ^2 tests. Clinical heterogeneity will be determined by consensus between the investigators on the basis of collective experience in the field.

If there are sufficient trials, exploratory meta-regression analyses will be undertaken to establish whether there is evidence of a differential impact of eHealth fall prevention interventions on balance, on the basis of intervention (type of intervention, duration of intervention), population characteristics or trial methodological quality.

Patient and public involvement

Patient and public involvement is beyond the scope of this systematic review. Although there was no patient and public involvement in this protocol, the topic is of interest and has relevance to older people.

DISCUSSION

The results from this systematic review have the potential to benefit a large proportion of the population. Australia's population is ageing; as such the proportion of older people at risk of a fall-related injury[24] is increasing. Falls can negatively impact the quality of life, function, social connectedness, mental health and mortality of older people, resulting in significant economic burden experienced by the older person, their carer's and families, healthcare providers, the healthcare system and society.[4] As such it is important to determine if eHealth interventions can deliver a moderate-to-highly challenging balance exercise programme or intervention and improve balance in older people.

Ethics and dissemination

This study does not require ethical clearance.

The results of this systematic review have the potential to positively impact on the health of older people and those that care for them. If the results from this systematic review find eHealth interventions to have a significant impact on balance then it provides older people and those that care for them, and other stakeholders such as health professionals, with another avenue for the promotion of balance-based exercise and the prevention of falls. Therefore, the results of this study will be translated and communicated to older people and those that care for them, members of the community, health professionals to ensure that they have a positive impact on the health outcomes of older people.

Findings from this systematic review will be communicated through publication in a peer-reviewed journal, through conference presentations, as well as disseminated to local, state, national and international policymakers, healthcare professionals and administrators.

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