World Falls Guidelines for Prevention and Management of Falls in Older Adults

Appendix 2

Full recommendations report from the *World Falls Guidelines* stratified by working groups and ad hoc reviews

APPENDIX 2. Full recommendations report from World Falls Guidelines stratified by working groups and ad hoc reviews

This document contains the recommendations of the working groups and the ad hoc groups with their detailed justifications, practical tips and research priorities. The working groups (WGs) generally reported their findings and conclusions in a standardised structure but there is some variation between reports in structure and language. The Age and Ageing guidelines summary paper includes these recommendations with shortened versions of the details and justifications. To comply with the style and word limit for Age and Ageing, some of the terms used and other wording was altered for consistency.

Tabular summary

Working Group/Domains	Area or Domain	Recommendation	Grade
Working Group 1: Gait and balance assessments tools to assess risk for falls	Stratification	We recommend including Gait Speed (GS) for predicting falls risk. As an alternative the Timed Up and Go Test can be considered, although the evidence for fall prediction is less consistent.	1A 1B
	Assessment	We recommend that Gait and Balance should be assessed as part of the risk assessment of falls.	1B
Working Group 2: Polypharmacy, Fall Risk Increasing Drugs, and Falls	Assessment	We recommend assessing for fall history and the risk of falls before prescribing potential fall risk increasing drugs (FRIDs) to older adults.	1B
	Assessment	We recommend the use of a validated, structured screening and assessment tool to identify FRIDs when performing a general medication review or medication review targeted to falls prevention.	1C
	Interventions	We recommend that a medication review and appropriate deprescribing of fall-risk increasing drugs (FRIDs) should be part of multidomain falls prevention interventions.	1B
	Interventions	We recommend that in long-term care residents, the falls prevention strategy should always include rational deprescribing of fall-risk-increasing drugs.	1C
Working Group 3. Cardiovascular Risk Factors for Falls	Assessment	We recommend, as part of a multifactorial falls risk assessment, that a cardiovascular assessment that initially includes cardiac history, auscultation, lying and standing orthostatic blood pressure, and surface 12-lead electrocardiogram should be performed.	1B
	Assessment	In the absence of abnormalities on initial cardiovascular assessment, no further cardiovascular assessment is required, unless syncope is suspected (i.e. described or witnessed syncope/pre-syncope or recurrent unexplained falls).	1C
	Assessment	We recommend that the further cardiovascular assessment for unexplained falls should be the same as that for syncope, in addition to the multifactorial falls risk assessment.	1A

	Interventions	We recommend that management of orthostatic hypotension should be included as a component of multidomain intervention in fallers.	1A
	Interventions	We recommend that interventions for cardiovascular disorders identified during assessment for risk of falls should be the same as that for similar conditions when associated with syncope, in the addition to other interventions based on the multifactorial falls risk assessment.	1B
Working Group 4: Exercise and Physical Activity Interventions for the Prevention of Falls	Interventions	We recommend exercise programmes for fall prevention for community-dwelling older adults that include balance challenging and functional exercises (e.g. sit-to-stand, stepping) should be offered with sessions three times or more weekly which are individualised, progressed in intensity for at least 12 weeks and continued longer for greater effect.	1A
	Interventions	We recommend inclusion, when feasible, of Tai Chi and/or additional individualised progressive resistance strength training.	1B
	Interventions	We recommend individualised supervised exercise as a falls prevention strategy for adults living in long-term care settings.	1B
	Interventions	We recommend that adults with Parkinson's Disease at an early to mid-stage and with mild or no cognitive impairment are offered individualised exercise programmes including balance and resistance training exercise	1A
	Interventions	We conditionally recommend that older adults after a stroke should be offered participation in individualised exercise programmes aimed at improving balance/strength/walking to prevent falls	2C
	Interventions	We recommend that older adults after sustaining a hip fracture should be offered an individualised and progressive exercise programme aimed at improving mobility (i.e. standing up, balance, walking, climbing stairs) as a fall prevention strategy.	1B
	Interventions	We conditionally recommend that such programmes for older adults after a hip fracture are best commenced in hospitals and continued in the community.	2C (Inpatients) 1A (Community)
	Interventions	We recommend that community-dwelling older adults with cognitive impairment (mild cognitive impairment and mild to moderate dementia) should be offered an exercise programme to prevent falls.	1B
Working Group 5: Falls in Hospitals and Care homes	Hospitals Assessment	We conditionally recommend performing multifactorial falls risk assessment in all hospitalised older adults >65 years of age. We recommend against using scored falls risk screening tools in hospitals for multifactorial falls risk assessment in older adults.	2B

	Hospitals Assessment	We recommend conducting a post-fall assessment in hospitalised older adults following a fall in order to identify the mechanism of the fall, any resulting injuries, any precipitating factors (such as new intercurrent illness, complications or delirium), to reassess the individual's fall risk factors, and adjust the intervention strategy for the hospitalised older adults.	E
	Hospitals management and interventions	We recommend that a tailored education on falls prevention should be delivered to all hospitalised older adults (≥ 65 years of age) and other high-risk groups.	1A
	Hospitals management and interventions	We recommend that personalised single or multidomain falls prevention strategies based on identified risk factors or behaviours or situations should be implemented for all hospitalised older adults (≥ 65 years of age), or younger individuals identified by the health professionals as at risk of falls.	1C (Acute care) & 1B (Sub-acute care)
	Care homes assessment	We recommend against falls risk screening to identify care home residents at risk for falls, since all residents should be considered at high risk of falls.	1A
	Care homes assessment	We recommend performing a multifactorial falls risk assessment at admission to identify factors contributing to fall risk and implementing appropriate interventions to avoid falls and fall-related injuries in care home older adults.	1C
	Care homes assessment	We recommend conducting a post-fall assessment in care home residents following a fall in order to identify the mechanism of the fall, any resulting injuries, to reassess the resident's fall risk factors, adjust the intervention strategy for the resident and avoid unnecessary transfer to hospital.	E
	Care homes management and interventions	We recommend a multifaceted approach to falls reduction for care home residents including care home staff training, systematic use of a multidomain decision support tool and implementation of falls prevention actions.	1B
	Care homes management and interventions	We recommend against the use of physical restraints as a measure for falls prevention in care homes.	1B
	Care homes management and interventions	We recommend nutritional optimisation including food rich in calcium and proteins, as well as vitamin D supplementation as part of a multidomain intervention for falls prevention in care home residents.	1B
	Care homes management and interventions	We recommend including the promotion of exercise training (when feasible and safe) as part of a multidomain falls prevention intervention in care homes.	1C

Working Group 6. Cognition and Falls	Assessment	We recommend that routine assessment of cognition should be included as part of multifactorial falls risk assessment in older adults.	1B
	Assessment	We recommend including both the older adult and caregiver's perspectives, when creating the individual falls prevention care plans for adults with cognitive impairment since this strategy has shown better adherence to interventions and outcomes.	1C
Working Group 7: Falls and Parkinson's disease and Related Disorders	Assessment	We conditionally recommend a falls risk assessment for older adults with Parkinson's Disease, including a self-report 3-risk factor assessment tool, which includes a history of falls in the previous year, freezing of gait (FOG) in the past month, and slow gait speed.	2B
	Management and Intervention	We conditionally recommend that older adults with Parkinson's disease should be offered multidomain interventions, based on PD specific assessment and other identified falls risk factors.	2B
	Management and Intervention	We recommend that older adults with Parkinson's Disease at an early to mid-stage and with mild or no cognitive impairment should be offered individualised exercise programmes including balance and resistance training exercise.	1A
	Management and Intervention	We conditionally recommend offering exercise training, targeting balance and strength to adults with complex phase Parkinson's Disease if supervised by a physiotherapist or other suitably qualified professional.	1C
Working Group 8: Falls and Technology	Assessment and Interventions	We conditionally recommend using telehealth and/or smart home systems (when available) in combination with exercise training as part of falls prevention programmes in the community.	2C
	Interventions	Current evidence does not support the use of wearables for falls prevention. However, emerging evidence show that when wearables are used in exercise programmes to prevent falls, they may increase participation.	2C
Working Group 9: Falls in Low- and Middle-Income Countries	Implementation	Local context needs to be considered when implementing fall prevention programmes in low- and middle-income countries.	1B
	Assessment	We conditionally recommend prioritising assessments of risk factors for cognitive impairment, obesity including sarcopenic obesity, diabetes, lack of appropriate footwear and environmental hazards as falls risk factors in low- and middle-income countries.	2C
	Assessment	We conditionally recommend that clinicians and caregivers in low- and middle-income countries settings should preferably use validated tools that are freely available in their country of residence to assess mobility and fall risk.	E
Working Group 10:	Assessment	We recommend multiprofessional, multifactorial falls risk assessment to community-dwelling older adults	1B

Multifactorial Falls Risk Assessment and Interventions for Preventing Falls in Community-Dwelling Older Adults		identified to be at high risk of falling, to guide tailored interventions.	
	Interventions	We recommend offering multidomain interventions, informed by a multiprofessional, multifactorial falls risk assessment to community-dwelling older adults identified to be at high risk of falling.	1B
Working Group 11: Older Adults' Perspectives on Falls	Stratification	We recommend clinicians should routinely ask about falls in their interactions with older adults**.**	1A
	Assessment	As part of a multifactorial falls risk assessment, clinicians should enquire about the perceptions the older adult holds about falls, their causes, future risk and how they can be prevented.	1B
	Interventions	A care plan developed to prevent falls and related injuries should incorporate the values and preferences of the older adult.	1B
Working Group 12: Concerns about Falling and Falls	Assessment	We recommend including an evaluation of concerns about falling in a multifactorial falls risk assessment of older adults.	1B
	Assessment	We recommend using a standardised instrument to evaluate concerns about falling such as the Falls Efficacy Scale International (FES-I) or Short FES-I in community-dwelling older adults.	1A
	Assessment	We recommend using the FES-I or especially the Short FES-I for assessing concerns about falling in acute care hospitals or long-term care facilities.	1B
	Assessment	We recommend exercise, cognitive behavioural therapy and/or occupational therapy (as part of a multidisciplinary approach) to reduce concerns about falling in community-dwelling older adults.	1B
Ad hoc Expert Group 1 **Dizziness and Vestibular disorders and Falls**	Dizziness and Vestibular disorders and Falls	Routinely ask about dizziness symptoms, and undertake follow-up assessment as necessary to identify cardiovascular, neurological and/or vestibular causes.	E
Ad hoc Expert Group 2	Vision, Hearing and Falls	Enquire about vision impairment as part of a multifactorial falls risk assessment, measure visual acuity and examine for other visual impairments such as hemianopia and neglect where appropriate.	E
		Enquire about hearing impairment as part of a multifactorial falls risk assessment, measure and examine for hearing impairments and refer to a specialist where appropriate.	E
Ad hoc Expert Group 3	Environment and Falls	Identification of an individual's environmental hazards where they live and an assessment of their capacities and behaviours in relation to them, by a clinician trained to	1B

		do so, should be part of a multifactorial falls risk assessment.	
		Recommendations for modifications of an older adult's physical home environment for fall hazards that consider their capacities and behaviours in this context, should be provided by a trained clinician, as part of a multidomain falls prevention intervention.	1B
Ad hoc Expert Group 4	Vitamin D and Nutrition and Falls	Assess nutritional status including vitamin D intake as part of a multifactorial falls risk assessment, followed by supplementation where appropriate	E
Ad hoc Expert Group 5	Depression and Falls	Enquire about depressive symptoms as part of a multifactorial falls risk assessment, followed by further mental state assessment if necessary and referral to a specialist where appropriate.	E
Ad hoc Expert Group 6	Frailty and Falls	No recommendations specific to this condition	NA
Ad hoc Expert Group 7	Sarcopenia and Falls	No recommendations specific to this condition	NA
Ad hoc Expert Group 8	Delirium and Falls	No recommendations specific to this condition	NA
Ad hoc Expert Group 9	Pain and Falls	Enquire about pain as part of a multifactorial falls risk assessment, followed as indicated by a comprehensive pain assessment.	E
		Adequate pain treatment should be considered as part of the multidomain approach.	E
Ad hoc Expert Group 10	Urinary symptoms and incontinence and Falls	Enquire about urinary symptoms as part of a multifactorial falls risk assessment	E

Working Group 1: Gait and balance assessments tools to assess risk for falls

RECOMMENDATION 1 (Risk Stratification)

We recommend including Gait Speed (GS) for predicting falls risk. **GRADE 1A.**
As an alternative, the Timed Up and Go Test can be considered, although the evidence for fall prediction is less consistent. **GRADE 1B.**

RECOMMENDATION 2 (Assessment)

We recommend that Gait and Balance should be assessed as part of the risk assessment of falls. **GRADE 1B.**

RECOMMENDATION DETAILS

1. There are several tests for assessing gait and balance impairment. For risk stratification we recommend use of GS, with a cut-off value of <0.8 m/s on the basis of its predictive ability and simplicity. Resources with simple instructions on how to measure gait speed can be found at www.worldfallsguidelines/resources. Alternatively, the Timed Up and Go (TUG) test can be used, with a cut-off value of >15 seconds, although evidence for fall risk stratification is mixed. There is evidence that the TUG is predictive of falls in lower functioning adults.
2. Based on the existing evidence, we are unable to recommend using, as single stand-alone tests, Berg Balance Scale, Chair Stand test, One Leg Stand, or Functional Reach, for the prediction of falls in community-dwelling older adults. We acknowledge that these tests have value in assessing mobility and balance impairments and in identifying appropriate targeted interventions and, therefore, can be used for assessment purposes.
   The choice of assessments should consider the clinical characteristics of the older adult (e.g. frail vs non-frail), the setting (e.g. community, outpatient clinic, acute care, long-term care) and the resources available (e.g. cost, training, equipment). The choice of assessments should also consider the purpose of performing the test: Gait Speed (GS) has the best evidence for prediction of falls and for screening in a community-dwelling population to identify those at high falls risk. Other assessment tools may have value in providing more information to direct targeted intervention.
3. Dual Task (DT) tests (both cognitive and motor dual tasking) show promising results in falls prediction; however more research is warranted to determine the most appropriate protocols.
4. We recommend clinicians to adopt a holistic approach, combining gait and balance tools with other multidimensional tools and falls history to assess falls risk.

PRACTICAL TIPS

1. Ask the older adults about any perceived problems that they may have in their walking and /or balance. This will help determine the extent to which gait/balance tests should be used. An older adult with a subjective complaint of gait/balance problems should prompt a comprehensive gait/balance assessment, compared to an older adult who does not report gait/balance problems.
2. For GS assessment, ask the older adults to walk at their usual speed (if necessary, with a walking aid). We suggest 4-meter walking lengths and the use of a stopwatch to calculate speed (distance/time) [1].
3. For GS the optimal cut-off to predict falls has not been universally defined and accepted, although different cut-offs (e.g. 1 m/s, 0.8 m/s, 0.6 m/s) have been associated with various adverse health outcomes, including falls. Based on a systematic literature review, an International Academy on Nutrition and Ageing (IANA) expert panel advised to assess GS at usual pace over 4 meters and to use the easy-to-remember cut-off point of 0.8 m/s to predict the risk of adverse outcomes [2].

OBJECTIVE

To make an evidence-based recommendation through critical appraisal of the existing evidence (umbrella review) on assessments of gait and balance to predict falls in older adults.

SUMMARY OF FINDINGS

Previous guidelines recommend a multifactorial falls risk assessment with tailored intervention to prevent falls in community-dwelling older adults who are at an increased risk of future falls [3-7]. This involves identifying risk factors for each individual, particularly modifiable ones, and then taking action to try and reduce the risks [4, 5, 8]. Previous guidelines recommend an assessment of gait and balance for older adults at risk of falling, as these are considered important fall risk factors.

An examination of the literature from an umbrella review of the available evidence (i.e. a systematic review of review studies) demonstrated that the most frequently reported gait, balance, and physical functional assessments for falls prediction included the following tests: GS, TUG, BBS, CST, DT, FR, and OLS.

The umbrella review reported different results across different populations as well as different settings, making it important to consider the clinical characteristics of the older adult, the setting, and the resources available. As previous review studies have focused on fallers in general, prediction of the sub-group of recurrent fallers or injurious fallers have not been separated.

Gait Speed (GS)

GS is the measurement of the time it takes to complete a walk over a given distance in the participant's preferred or maximum pace [1, 9] and was reported in seven review papers [10]. The best available evidence suggested that gait speed was a useful measure in predicting falls.

Timed Up and Go (TUG)

The TUG consists of a combination of standing from a chair and walking [11]. Across twelve review studies, the evidence was inconsistent on the ability of the TUG to predict falls, although there is evidence that it can predict falls in the lower functioning groups [10].

Berg Balance Scale (BBS)

The BBS is a balance test with a series of tasks [12]. Across nine review papers [10], the evidence for using the BBS to predict falls was inconsistent. Therefore, the use of the BBS as a balance assessment used in isolation is not recommended to predict falls [13, 14].

Chair Stand Test (CST)

The CST measures the ability to get up from chair without using arms, time taken to get up five times, or number of chair stands over 30 seconds. Across five review papers, the evidence was inconsistent for the ability of CST to predict falls [10].

One Leg Stance (OLS)

The OLS test is a single leg standing balance test [15]. Across three review papers, the evidence was inconsistent for the ability of the OLS to predict falls [10].

Functional Reach Test (FR)

The FR test is a functional balance test [16]. Across seven review papers, the evidence was inconsistent for the ability of the FR test to predict falls [10].

Dual Task (DT) Assessments

DT assessments are the combination of a physical task (such as walking) and either a second physical task (such as holding an object) or a cognitive task (such as counting) [17]. Across six review papers [10], the evidence for the ability of DT assessments to predict falls over single gait speed or balance tests was inconsistent; however, the evidence from the higher quality reviews suggested that DT assessments had the ability to predict falls [10]. The optimal type of DT assessments is still unclear This finding implies that additional tests of dual task gait speed are not required for assessing falls risk in clinical practice and that a simple gait speed measure is enough.

However, dual task gait paradigms may be helpful in exploring specific attentional and execution function requirements of balance and walking, which may assist in guiding interventions to maintain cognitive and physical health in older age.

Other Tests

Other tests are also used in falls assessments, but studies reporting on their falls predictive ability have been inconsistent and therefore cannot currently be recommended as single assessment tools used alone in the prediction of falls. These include The Tinetti test and the Performance-Oriented Mobility Assessment (POMA) test, which are task-oriented balance tests, the tandem stance and gait which are standing balance and heel to toe walking tests respectively [10].

Combination

Evidence from the current umbrella review demonstrates that it is important to combine different risk assessment tools together with a falls history in the previous year, to predict falls in older adults [10], especially as fall risk factors are multi-dimensional ranging from physical to psychological and environmental factors [18]. Only one physical assessment (GS) showed moderate evidence for predicting falls. Fall-related psychological concerns (e.g. fear of falling and self-efficacy) [19-21] also constitute important falls risk factors. Thus, these psychological assessments should be integrated into the holistic toolkit for falls prediction[18, 22]. (See WG12 on concerns about falling)

JUSTIFICATION

Evidence for this recommendation has emerged from a review of the literature, with specifically an umbrella review of the available evidence [10].

SUBGROUP AND SETTINGS CONSIDERATIONS

GS is an important measure in the comprehensive geriatric assessment, within all clinical settings, for predicting falls and for the purposes of developing risk profiles for older adults [23]. There is some evidence, from one subgroup analysis, that the TUG may have a role in fall prediction for older adults with lower function [24]. One review reported that the BBS may predict falls in a stroke clinic population [25]. One review reported that the FR may predict falls in older adults with cognitive impairment [22]. There is well-established evidence indicating that dual task gait (slowing speed or higher dual task cost) has the ability to predict dementia [26]; similarly, the best available evidence suggested that dual task testing can predict falls, although the optimal type of dual task test is still unclear [10].

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS

GS is a suitable test that can easily be implemented in the standard clinical evaluation of older adults [1], due to its ease and efficiency of administration, low cost, and reliability. GS can also predict other important health-related outcomes [2, 27, 28]. Positive results have been found for a 4-meter gait speed assessment, which is also the recommended length of measurement in a systematic review from the IANA task force, which reported that gait speed was a strong and consistent predictor of adverse outcomes in community-dwelling older adults [2].

MONITORING AND EVALUATION

For monitoring the effectiveness of interventions to reduce falls, it is important to use the established minimal level of change of the assessments, and consideration should be given to clinical meaningful changes.

RESEARCH PRIORITIES

1. Further research is needed to evaluate how different tools combining balance and physical functional assessment like the Short Physical Performance Battery (SPPB) can predict falls and be clinically applied. The SPPB is increasingly being used in clinical and research settings; however, the umbrella review was unable to determine its predictive ability, as it was not reported in the included reviews [10].

2. Current evidence shows that DT assessment has the ability to predict falls; however future research defining the optimal DT protocol with regards to fall prediction is still warranted.
3. The combination of the best assessment tools needs to be defined for different settings (e.g. community, outpatient clinic, acute care, long-term care), specific clinical characteristics of the older adult (e.g. cognitive impairment, stroke, Parkinson's disease), different levels of functional status, and different levels of frailty.
4. There is increasing interest and research on developing fall prediction models, which combine data from different domains to calculate falls risk. Research focusing on a combination of different fall risk factors in these prediction models is warranted [29, 30].
5. Future fall prediction research should focus on feasibility and cost-effectiveness of assessments.
6. Future fall prediction research should also include older adult and public involvement. The development and implementation of relevant assessment tools should take into account older adults' and public values and preferences.

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Working Group 2: Polypharmacy, Fall Risk Increasing Drugs, and Falls

RECOMMENDATION 1 (Assessment)
We recommend assessing for fall history and the risk of falls before prescribing potential fall risk increasing drugs (FRIDs) to older adults. **GRADE 1B.**

RECOMMENDATION DETAILS
1. Before prescribing potential FRIDs to older adults, enquire about falls and consider the relative benefits and risks of initiating therapy.
2. The possibility of a safer (non)-pharmacological option for treatment (besides a FRID) should be considered if it is available and suitable for the clinical condition being treated.

PRACTICAL TIPS
1. For example, the following initiatives have listed FRIDs: Centre for Disease Control and Prevention's STEADI initiative https://www.cdc.gov/steadi/steadi-rx.html and STOPPFall [1].
2. When available, use tools for assessment of the appropriateness of prescribing such as the STOPP/START, STOPPFall, STOPPFrail, Beers Criteria, FORTA or Web-based Meds 75+ Guide [1-5].
3. Older adults characteristics, including frailty status, polypharmacy, other FRIDs, co-morbidities, life expectancy, older adult's preferences and other geriatric syndromes should be considered when prescribing.
4. Shared decision-making (SDM) approaches are helpful when personalizing strategy. SDM has been shown to result in better-informed individuals. Furthermore, SDM improves compliance.
5. A medication review should be provided regularly, at least yearly as a minimum interval. For people living with frailty, and therefore prone to more rapid changes, this is preferably done every 6 months.

OBJECTIVE
Adults aged 65 years and older have an increased risk of falls. Several central nervous system (CNS) drugs and cardiovascular drugs are strongly associated with an increased risk of falls in older adults. A pragmatic prevention approach to prevent falls is to identify older adults at risk for falls and try to find a treatment option that is safer than FRID, available and clinically suitable for older adults. The objective was to summarise the literature regarding FRIDs as risk factors for falling.

SUMMARY OF FINDINGS
Systematic reviews and meta-analyses have shown strong evidence that several drug groups, including all kinds of psychotropics, antiepileptics, anticholinergics and some classes of cardiovascular drugs are important risk factors for falling in older adults [6-10]. Especially, psychotropics have been consistently associated with increased risk of falling across different meta-analyses. For example, a meta-analysis published in 2018 using adjusted data showed the following pooled ORs: antipsychotics 1.54 [95% confidence interval (CI) 1.28-1.85], antidepressants 1.57 (95% Cl 1.43-1.74), and benzodiazepines 1.42 (95%, CI 1.22-1.65) [10]. In addition, there are many original articles showing the risk of falling of several specific drugs. Tools for assessment of the appropriateness of prescribing such as for example the STOPP/START, STOPPFall, STOPPFrail, Beers criteria, FORTA, and Web-based Meds75+ guide aim to reduce inappropriate prescribing and are appropriate tools to be used by professionals when making prescribing decisions [1-5]. Together with a holistic assessment of older adults, these tools can help to identify and limit the use of potential FRIDs.

JUSTIFICATION
There is strong evidence that certain medications' use increases fall risk in older adults, that a structured approach improves FRID identification and that medication review and deprescribing of FRIDs can significantly reduce fall risk. If FRIDs prescription is needed, minimum effective dosage and shortest prescription period should be carefully considered. Also, timely re-assessments are warranted to identify if older adults are developing adverse drug reactions.

SUBGROUP AND SETTINGS CONSIDERATIONS

Falling aggravated by the use of FRIDs is a critical issue for multi-morbid older adults and therefore this recommendation is valid for all settings: community, hospital and long-term care (including residential care and care homes).

IMPLEMENTATION CONSIDERATIONS

In prevention of falls due to FRIDs, no prescriptions of FRIDs if safer and suitable (non)-pharmacological alternatives are available could be a successful strategy to prevent falls in older adults.

MONITORING AND EVALUATION

When prescribing medications in older adults, assessment for fall risk is always needed and the knowledge of FRIDs can help guide clinicians to weigh risks and benefits of treatments and thus provide safer treatments for older adults.

In addition, regular medication review is important due to unstable health conditions in older people. Over time, the benefits versus risks of medication change, highlighting the need for regular reassessment. In addition, the complexity of healthcare systems with multiple prescribers demands regular medication reviews. As FRIDs review is an essential part of the medication review, their regularity will help to keep the exposure to FRIDs as short as clinically indicated. This can reduce fall risk in older adults. This is particularly important for subgroups of frail older adults, who are especially at increased risk of falls [11] and ADEs [12]. Thus, medication review (including FRIDs review) is preferably performed every 6 months in frail older adults as their health situation can alter quickly over time. In non-frail older adults, medication review (including FRIDs review) is preferably performed at least annually.

Working Group 2: Polypharmacy, Fall Risk Increasing Drugs, and Falls

RECOMMENDATION 2 (Assessment)

We recommend the use of a validated, structured screening and assessment tool to identify FRIDs when performing a general medication review or medication review targeted to falls prevention. **GRADE 1C.**

RECOMMENDATION DETAILS

1. Incorporate medication-review tools to systematically identify medication-related fall risks in older adults and to optimise deprescribing.

PRACTICAL TIP

STOPPFall is a screening tool used to identify drugs that increase the risk of falls in older adults. An online interactive version of the STOPPFall deprescriving tool is freely available: https://www.eugms.org/research-cooperation/task-finish-groups/frid-fall-risk-increasing-drugs.html

OBJECTIVE

Polypharmacy and use of certain drugs are strongly associated with increased risk for falls in older adults (particularly central nervous system (CNS) drugs and cardiovascular drugs).

The objective was to review the literature to evaluate if a structured assessment of FRIDS e.g. by utilizing a screening and assessment tool within a medication review is warranted.

SUMMARY OF FINDINGS

Currently, several tools for assessment of the quality of prescribing including STOPP/START (Screening Tool of Older adults potentially inappropriate Prescriptions/Screening Tool to Alert doctors to Right Treatment), Beers criteria, FORTA (Fit fOR The Aged)-list and TIME (Turkish Inappropriate Medication use in the Elderly) are available to guide professionals in appropriate mediation use [2-4, 13, 14]. These drug-optimisation strategies include some aspects of falls prevention, as FRIDs are mostly labelled as potential falls causative

factors. Although these tools are not comprehensive in their FRIDs listing, their use in intervention studies has been shown to reduce falls [15, 16]. The existing lists do not represent a complete and uniform medication list to be avoided in older adults at risk of falls [17].
The European Geriatric Medicine Society (EuGMS) Task and Finish Group on FRIDs described in their statement paper generic steps for FRIDs withdrawal, from medication review to symptom monitoring after deprescribing [18]. Recently an international consensus on assessment and deprescribing tool was developed as part of the STOPP-START tools, the STOPPFall [1, 3]. Use of STOPPFall medications has been associated with falls in hospital setting [19].

JUSTIFICATION
There is limited evidence that assessment of FRIDs within medication review and deprescribing of FRIDs as a single intervention can successfully reduce falls. However, incorporating a medication review in a holistic multifactorial fall risk assessment with a view to deprescribing of FRIDs, where appropriate, is warranted [17]. In addition, deprescribing based on comprehensive medication review may reduce mortality and potentially inappropriate medications and it has been suggested that deprescribing could be safe, feasible, well tolerated and can lead to important benefits in frail individuals [20, 21]. A structured approach is included in the definition of medication reviewing as determined by, among others, the NICE guidelines [22]. Guideline recommendations on the structured approach include advice to use an appropriate tool that is easy to use [23].

SUBGROUP AND SETTINGS CONSIDERATIONS
Inappropriate prescribing is considered an important issue for multi-morbid older people and therefore this recommendation is valid for all settings: community, hospital, and long-term care (including residential care and care homes) [24-26].
IMPLEMENTATION CONSIDERATIONS AND TOOLKITS
Deprescribing is often a challenging process. Therefore, an assessment and deprescribing tool can help to support rational deprescribing. Utilizing screening tools such as STOPPFall could potentially improve the quality of medication reviews and appropriate deprescribing in older people at risk of falls [1].
If a structured approach is not feasible e.g. due to lack of time, then a non-structured approach is an alternative.

MONITORING AND EVALUATION
A structured assessment of FRIDs, within a medication review should be provided regularly i.e. at least annually. For older adults living with frailty, and therefore prone to more rapid changes, this is preferably done every 6 months.

RESEARCH PRIORITIES
STOPPFall has been shown to be predictive of falls in a hospital setting. Further studies are needed to demonstrate the effectiveness of STOPPFall and other deprescribing tools in falls prevention in different clinical settings.

Working Group 2: Polypharmacy, Fall Risk Increasing Drugs, and Falls

RECOMMENDATION 3 (Interventions)
We recommend that a medication review and appropriate deprescribing of fall-risk increasing drugs (FRIDs) should be part of multidomain falls prevention interventions. **GRADE: 1B**

RECOMMENDATION DETAILS
1. Multidomain interventions (i.e. a combination of interventions tailored to the individual), when followed and delivered, are effective for reducing the rate of falls in moderate to high-risk community older adults (see WG 10, recommendation 1) Multidomain interventions are also recommended for hospitalised older adults and long-term care residents (see WG 5 falls in hospital recommendations and falls in care homes).

2. The effect of FRIDs on fall risk is likely dependent on older adult characteristics. Thus, these older adult characteristics, including frailty status, polypharmacy, other FRIDs, co-morbidities, life expectancy, individual preferences, and other geriatric syndromes should be considered when performing a medication review.

PRACTICAL TIPS

1. It is preferable that the medication review is performed within a comprehensive geriatric assessment as this will take into account all relevant information for that individual in a structured way.
2. The personalised strategy should consider the older adult's values/preferences and individual characteristics such as comorbidity, frailty status and setting.
3. Shared decision-making (SDM) results in better-informed individuals who tend to opt for deprescribing more often. Furthermore, SDM improves compliance.
4. For successful implementation of both falls prevention and deprescribing, education of both older adults and health care professionals may help.

OBJECTIVE

One of the typical components of a multifactorial falls prevention strategy is the identification and rational deprescribing of certain medications. The rationale behind this intervention is the establishment of specific medications as risk factors for falls and the reversibility, after deprescribing, of possible adverse effects leading to falls such as the presence of orthostatic hypotension or sedation.

The term "deprescribing" has been described as "the process of withdrawal of an inappropriate medication, supervised by a health care professional with the goal of managing polypharmacy and improving outcomes" [27]. The objective was to assess whether medication review and deprescribing of FRIDs should be included in the multidomain falls prevention intervention.

SUMMARY OF FINDINGS

Medication review with the aim of deprescribing FRIDs is a standard component of multidomain interventions to prevent falls, which have been proven effective in reducing the rate of falls (for details we refer to WG 10) [28]. A multidomain intervention, including a medication review, is warranted in populations at risk of falls [29]. In a recent systematic review and network meta-analysis, following components of multiple interventions were associated with reduction in number of fallers and falls rate: exercise (exerc), assistive technology (assist), environmental assessment and modifications (envir), quality improvement strategies (qualt), and basic falls risk assessment (e.g. medication review) (brisk). The combinations of interventions including brisk had the following risk ratios for number of fallers: assist+brisk 0.52 (95% CI 0.30–0.90), envir+assist+qualt+hypot+brisk 0.62 (95% CI 0.43–0.88), qualt+brisk 0.84 (95% CI 0.73–0.96), exerc+envir+assist+qualt+brisk 0.85 (95% CI 0.74–0.98), exerc+management of urinary incontinence +envir+assist+qualt+brisk 1.58 (95% CI 1.01–2.48) and rate ratios for falls rate: envir+assist+qualt+management of orthostatic hypotension (hypot)+brisk: 0.42 (95% CI 0.30–0.58), exerc+envir+assist+hypot+brisk 0.73 (95% CI 0.59–0.92), exerc+qualt+hypot+brisk 2.08 (95% CI 1.34–3.25), exerc+fluid or nutrition therapy +envir+assist+brisk 1.84 (95% CI 1.14–2.97) [28]. This is line with a recent systematic review of published falls prevention guidelines, which reported that the majority of guidelines included medication review as a component of the multidomain intervention likewise to the summary reports of the WHO [30-33].

Medication review is a complex intervention in which the potential beneficial effects of therapy must be balanced against potential and experienced adverse drug events [18]. Also, studies have shown that the effect of FRIDs on fall risk is likely dependent on individual characteristics [34]. Thus, individual characteristics, including frailty status, polypharmacy, other FRIDs, co-morbidities, life expectancy, individual preferences and other geriatric syndromes, should be considered when performing a medication review as part of shared decision-making approach [35]. The review needs to be a holistic assessment, for example through a comprehensive geriatric assessment, to produce a personalised medication strategy that also includes older adult's perspectives (goals and preferences) [35].

JUSTIFICATION

Medication review and deprescribing should be a standard component of the multifactorial approach. Due to very heterogeneous approaches and research populations, it is difficult to determine the optimal content of the FRIDs deprescribing component, since in studies this varied between single drug group deprescribing (e.g. benzodiazepines) to a broad deprescribing approach [36, 37]. In general, when conducting a medication review as a part of a multidomain intervention, deprescribing of FRIDs can be performed safely in older adults at risk of falls [38]. Few adverse withdrawal effects occur, and if symptoms re-occur, they can be safely treated by restarting the withdrawn medication or if possible, a safer alternative [38, 39]. There are some data available on the rate of re-prescribing of FRIDs and depending on the drug groups, this varies between 0-50% [38, 39].

SUBGROUP CONSIDERATIONS

Studies have shown that the effect of FRIDs on fall risk is likely dependent on individual characteristics as explained above [34].

A medication review will not lead to similar recommendations in different individuals due to the heterogeneity in the older population and their respective pharmacotherapy. Older adult's preferences should be incorporated into treatment decisions via SDM. As the level of evidence on the benefit versus risk ratio of medications is low in this older adult population, most decisions about deprescribing or continuing are preference sensitive. SDM can result in better-informed individuals who opt for deprescribing more often. Hence, SDM is essential component of deprescribing.

IMPLEMENTATION CONSIDERATIONS

In general, the barriers and enablers for deprescribing can be categorised into environmental (e.g. regulatory, financial, policy), healthcare organisation, provider, and individual/public related factors [40]. Lack of knowledge and skills is a significant barrier to healthcare professionals' capacity to implement effective fall-prevention approaches [41]. The withdrawal of FRIDs and not being able to predict the outcome of changes in pharmacotherapy are perceived as challenging by many physicians [42]. In addition, some older adults are also hesitant to stop their medication, fearing withdrawal reactions and relapse of their disease [43]. Finally, successful deprescribing of FRIDs may be short-lived as older adults or doctors may initiate their resumption, especially for psychotropics [44]. For the long-term success of deprescribing, provision of education, monitoring, support, and documentation are crucial [1]. For successful implementation, education of older adults, family members/caretakers and health care professionals is essential. Also, structured follow-up of symptoms is warranted [9, 26]. Given the complexity of the intervention, supporting structured tools (such as STOPPFall) are warranted accompanied with appropriate training [41, 45]. Given the complexity of the intervention, allocation of sufficient time and resources is necessary to optimise success rate and effectiveness. Preferably the person conducting medication review and deprescribing has expertise in conducting these reviews.

MONITORING AND EVALUATION

Long-term success of deprescribing can be increased by provision of monitoring, support, and documentation. For future studies, more comparability is warranted in terms of targeted medication classes. For successful long-term effect of the deprescribing intervention, a medication review should be provided regularly, at least yearly as a minimum interval. For frail older adults, this is preferably done every 6 months as their health situation can alter quickly over time.

Working Group 2: Polypharmacy, Fall Risk Increasing Drugs, and Falls

RECOMMENDATION 4 (Interventions)
We recommend that in long-term care residents, the falls prevention strategy should always include rational deprescribing of fall-risk-increasing drugs. **GRADE 1C.**

RECOMMENDATION DETAILS
1. We could not find evidence to enable a recommendation on medication review and deprescribing as a single intervention in community dwellers or hospitalised older adults.
2. Multidomain interventions are recommended for long-term care residents (see WG 5 falls in care homes). This recommendation is meant to underline the importance of the medication review in long-term care residents.
3. The effect of FRIDs on fall risk is likely dependent on individual characteristics. Thus, these characteristics, including frailty status, polypharmacy, other FRIDs, co-morbidities, life expectancy, older adult's preferences, and other geriatric syndromes should be considered when performing a medication review.

PRACTICAL TIPS
1. Shared decision-making (SDM) approaches are helpful when personalizing strategy. SDM has been shown to result in better-informed individuals who tend to select deprescribing more often. Furthermore, SDM improves compliance.
2. For successful implementation of deprescribing interventions to reduce risk of falls in older adults, education of both older adult, family members and health care professionals may help.
3. Long-term success of deprescribing can be increased by provision of monitoring, support, and documentation.

OBJECTIVE
The objective was to assess deprescribing and medication review interventions as a single intervention in falls prevention. The intervention could be any deprescribing or medication review intervention.

SUMMARY OF FINDINGS
In total, 49 RCTs with heterogeneous interventions and results were included in the systematic review [37].

Community
Meta-analyses of medication reviews resulted in a risk ratio (RR) of 1.05 (95% Cl 0.85-1.29, I^2=0%, 3 studies) for number of fallers, in a RR=0.95 (95% Cl 0.70-1.27, I^2=37%, 3 studies) for number of injurious fallers and in a rate ratio of 0.89 (95% Cl 0.69-1.14, I^2=0%, 2 studies) for injurious falls.

Hospital
Meta-analyses analysis assessing medication reviews resulted in a RR=0.97 (95% Cl 0.74-1.28, I^2=15%, 2 studies) for number of fallers after hospital admission. Meta-analysis investigating evaluation of medications according to the Fit fOR The Aged criteria resulted in a RR 0.50 (0.07-3.50, I^2=72% %, 2 studies) for number of fallers during hospital admission.

Long-term care (including residential care and care homes)
Meta-analyses investigating medication reviews or deprescribing plans resulted in a RR=0.86 (95% Cl 0.72-1.02, I^2=0%, 5 studies) for number of fallers and a rate ratio of 0.93 (95% Cl 0.64-1.35, I^2=92%, 7 studies) for number of falls.

JUSTIFICATION
In a systematic review and meta-analysis on the effectiveness of deprescribing as a single intervention in falls prevention, no significant associations between medication reviews in any of the geriatric care settings and fall

outcomes were found [37]. However, there was a trend for a lower number of fallers in the meta-analysis assessing medication reviews in long-term care, possibly indicating that in a frail subgroup of older adults, rational deprescribing might be effective also as a single intervention. Therefore, our expert opinion is to recommend always the inclusion of rational deprescribing of fall-risk-increasing drugs in the falls prevention strategy in long-term care residents. Furthermore, several other studies with heterogeneous interventions and results not included in the meta-analyses were identified. Since the conducted studies are very heterogeneous, it is difficult to estimate the effect of deprescribing as a single intervention. The health benefits likely outweigh the harms.

SUBGROUP CONSIDERATIONS

The recommendation is valid for the long-term care setting (including residential care and care homes). Since there was a trend for a lower number of fallers in the meta-analysis assessing medication reviews in long-term care only. For frail subgroups residing in long-term care rational deprescribing might be performed as a stand-alone intervention.

IMPLEMENTATION CONSIDERATIONS

The interventions should involve the individual, their representatives, and healthcare professionals to focus on the multidisciplinary team-centred approach to facilitate the implementation. Education and engagement are essential for the implementation uptake of a complex intervention such as a medication review [40]. For successful implementation, education of both older adults and health care professionals is essential [18]. Given the complexity of the intervention, supporting structured tools (such as STOPPFall) are warranted accompanied with appropriate training [1, 41]. Also, allocation of sufficient time and resources is necessary to optimise success rate and effectiveness. Preferably the person conducting medication review and deprescribing has expertise in geriatrician or experienced clinician. Furthermore, adequate standardised protocols should be available for deprescribing in care homes. Finally, in case of very limited resources for falls prevention, the importance of exercise should be noticed.

MONITORING AND EVALUATION

Long-term success of rational deprescribing can be increased by provision of monitoring, support, and documentation. Monitoring is essential as without proper monitoring deprescribing can be harmful. For successful long-term effect of the deprescribing intervention, a medication review should be provided regularly, at least yearly.

RESEARCH PRIORITIES

For future studies, more comparability is warranted in terms of targeted medication classes. Furthermore, future research should focus on understanding how we can optimise deprescribing in long-term care facilities.

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Working Group 3. Cardiovascular Risk Factors for Falls

RECOMMENDATION 1 (Assessment)
We recommend, as part of a multifactorial falls risk assessment, that a cardiovascular assessment that initially includes cardiac history, auscultation, lying and standing orthostatic blood pressure, and surface 12-lead electrocardiogram should be performed. **GRADE 1B.**

RECOMMENDATION 2 (Assessment)
In the absence of abnormalities on initial cardiovascular assessment, no further cardiovascular assessment is required, unless syncope is suspected (i.e. described or witnessed syncope/pre-syncope or recurrent unexplained falls). **GRADE 1C.**

RECOMMENDATION DETAILS

1. The commonest cardiovascular causes of falls in rank order are orthostatic hypotension, vasovagal syndrome, carotid sinus hypersensitivity, bradyarrhythmias and atrial and ventricular tachyarrhythmias [1].
2. The investigation (and subsequent management and specialist referral criteria) of syncope, and therefore, recurrent unexplained falls can be performed according to locally applicable guidelines such as the **2018 ESC Guidelines for the diagnosis and management of syncope** [2].
3. Core components of the initial cardiovascular assessment includes history and a physical examination with postural vitals (pulse and BP) as a minimum, and cardiac auscultation and a 12-lead ECG when available. This needs to be performed by a trained clinician.
4. Clinical characteristics which suggest an underlying cardiovascular cause include palpitations, pre-syncope, syncope and chest pain. Other concerning features would include breathlessness, persistent bradycardia or an undiagnosed systolic murmur.
5. Symptom reproduction during an abnormal cardiovascular response, such as the older adult falls or near falls during orthostatic hypotension or a rhythm disturbance, validates a causal association. Alternatively, identification of a specific abnormal cardiovascular response may indicate a causal association without contemporaneous symptoms. The presence of more than one risk factor for falls is not uncommon, including cardiovascular risk factors. Clear causality for a single risk factor may be difficult to establish, therefore all modifiable cardiovascular risk factors should be addressed.
6. Orthostatic hypotension most commonly occurs as a result of dehydration, concomitant medications, autonomic dysfunction and with alpha synucleopathy diseases (such as PD, dementia with Lewy Bodies or multisystem atrophy). It is also common in older adults with hypertension.
7. For assessment for orthostatic hypotension, individuals should be supine for at least 5 minutes before baseline BP is recorded; on standing, BP should be taken as soon as possible (40-60 seconds), followed by measurements at 1-minute intervals up to 3 minutes, or up to 5 minutes if symptoms suggested a delayed orthostatic hypotension response [2, 3].
8. If orthostatic hypotension is suspected but not detected using traditional methods – Oscillometer or sphygmomanometer, referral for beat-to-beat orthostatic measurement is recommended as the association of falls with orthostatic hypotension measured using beat-to-beat methods is more consistent.

Working Group 3. Cardiovascular Risk Factors for Falls

RECOMMENDATION 3 (Assessment)
We recommend that the further cardiovascular assessment for unexplained falls should be the same as that for syncope, in addition to the multifactorial falls risk assessment. **GRADE: 1A.**

RECOMMENDATION DETAILS

1. Recurrent unexplained falls are most likely associated with a cardiovascular cause [2, 4-6].
2. For unexplained falls, a full multifactorial falls risk assessment should be performed, including a further cardiovascular assessment.
3. The investigation (and subsequent management and specialist referral criteria) of syncope, and therefore recurrent unexplained falls can be performed according to locally applicable guidelines such as the **2018 ESC Guidelines for the diagnosis and management of syncope** [2].
4. Events where there is transient loss of consciousness may be unwitnessed in many older adults meaning that collateral histories may not be available, which makes discrimination between falls and syncope challenging if individuals have poor recall of characteristics of events and whether or not transient loss of consciousness (either syncope or epilepsy) occurred [6]. If unwitnessed falls are unexplained, not due to accidental slips or trips (see definition in Age Ageing paper), it is possible that the individual experienced a syncopal event and displayed lack of awareness for LOC [7, 8]. In which case, assessment for cardiovascular causes of syncope/unexplained fall is indicated.
5. If vasovagal syncope or delayed orthostatic hypotension is suspected and diagnostic uncertainty remains, older adults should be referred for head up tilt tests [2, 9].
6. If arrhythmias are suspected after clinical assessment, based on locally applicable guidelines older adults should be referred for external or internal cardiac monitoring [2, 10, 11].
7. Older adults with unexplained syncope, suspected syncope or unexplained falls who require carotid sinus massage (CSM) or head up tilt tests should be referred to an appropriate specialist, according to locally applicable guidelines [2].
8. Heart rate and blood pressure responses to carotid sinus stimulation should be recorded. There is strong consensus that the diagnosis of carotid sinus syndrome (CSS) requires both the reproduction of spontaneous symptoms during carotid sinus stimulation (CSM) and clinical features of spontaneous syncope or unexplained falls compatible with a reflex mechanism. This is consistent with the recommendation of 2018 ESC guidelines [2]. Older adults with falls due to CSS may be unaware of loss of consciousness produced during CSM. The quality of evidence is moderate and is given by studies of ECG correlation between CSM and spontaneous events, and indirectly by studies of efficacy of cardiac pacing. Further research is likely to have an important impact on our confidence in the estimation of effect and may change the estimate.

SUMMARY OF FINDINGS FOR RECOMMENDATIONS 1 AND 2

Cardiac arrhythmia (arrhythmia, atrial fibrillation, ventricular arrhythmia)

- From the 12 studies that investigated cardiac arrhythmias and falls, 8 were concerned specifically with atrial fibrillation [12-19], 1 ventricular fibrillation [20], and 3 arrythmias in general with no further classification [21-23]. From the 8 studies investigating atrial fibrillation and falls, 5 reported significant positive relationships (3 multivariate [12, 13, 18], 2 univariate [14, 15]) and 3 were non-significant [16, 17, 19]. Of the studies showing a significant relationship the mean QA score was 6.4 (range 5 to 8). For those showing no significant relationship the QA score was 7.3 (range 6 to 8). The single study investigating ventricular fibrillation reported no significant relationships with falls and had a QA score of 8. From the 3 studies investigating arrhythmias in general 2 reported significant positive multivariate relationships [21, 22] with a mean QA score of 7 (range 6 to 8) , and 1 reported no significant relationship [23] with a QA score of 8.
- Comments: though relatively inconsistent, there is more often than not an association between cardiac arrhythmias and falls. (We recommend that in the context of unexplained falls the screening for an arrhythmia is pursued with ECG, external loop recorder, and ultimately possibly an implantable loop recorder).

Heart failure

- From the 10 studies that investigated heart failure and falls, 6 reported a significant positive relationship (5 significant multivariate relationship [5, 22, 24-26]; 1 significant univariate relationship [27]). Of the studies that showed a significant relationship, the mean quality assessment score was 6.8 (range 5 to 8); for those showing no significant relationship [16, 17, 21, 28] the mean score was 7.8 (6 to 9).

Unspecified cardiovascular disease

- From the 20 studies that investigated general cardiovascular disease and falls, 10 reported significant positive relationships (5 significant multivariate relationship [24, 29-32], 5 significant univariate relationship [33-37]). Of the studies that showed a significant relationship, the mean quality assessment score was 6.4 (range 2 to 8); for those showing no significant relationship [38-47] the mean score was 6.5 (4 to 10).

Stroke and Transient Ischaemic Attack (TIA)

- From the 23 studies that investigated prior stroke or TIA and falls, 10 reported significant positive relationships (7 significant multivariate relationship [10, 21, 25, 48-51], 3 significant univariate relationship [30, 46, 52]). Of the studies that showed a significant relationship, the mean quality assessment score was 7.6 (range 7 to 8); for those showing no significant relationship [16, 27-29, 35, 37, 45, 53-58] the mean score was 7.8 (5 to 10).

Hypertension

- From the 51 studies investigating hypertension and falls, 16 reported a significant relationship: 13 a significant positive relationship [33, 34, 50, 55, 57-64] (8 significant multivariate relationship [34, 55, 59, 60, 62-65], 5 significant univariate relationship [33, 50, 57, 58, 61]); 3 reported a significant negative multivariate relationship [48, 66, 67]. Of the studies that showed a significant positive relationship, the mean quality assessment score was 5.9 (range 3 to 8); for the studies reporting a significant negative relationship the mean quality assessment score was 6.3 (range 6 to 7); for those showing no significant relationship [5, 12, 16, 17, 21, 22, 24, 25, 27, 32, 35-37, 40, 41, 43, 44, 46, 52, 53, 68-82] the mean score was 6.6 (2 to 9).
- Further, two interventional studies [83, 84] were identified examining the impact of intensive blood pressure control treatment (maintenance of systolic blood pressure ≤ 120 mmHg), compared to standard treatment (maintenance of systolic blood pressure ≤ 140 mmHg) on falls among adults aged ≥ 50 years with hypertension. Both studies observed no significant difference in falls among the intensive blood pressure treatment group, compared to the standard treatment group. The quality of these two interventional studies was evaluated using the Revised Cochrane Risk of Bias tool for randomised trials (RoB 2) [85]: both studies were considered to have a “high risk”.
- Comments: While there appears to be inconclusive evidence to make definitive recommendations directly concerning the association between hypertension and falls among adults aged ≥ 50 years, intensive treatment of hypertension, these data suggest, does not result in a decrease in falls among older adults aged ≥ 50 years.

Postprandial hypotension

- From the 4 studies that investigated postprandial hypotension and falls, 1 reported a significant positive multivariate relationship [86]. This study had a quality assessment score of 6. Of the studies that showed no significant relationship [87-89], the mean quality assessment score was 4.7 (range 3 to 6).

Low blood pressure and falls

- Two studies investigated low blood pressure and falls [47, 68]. Both reported no significant relationship, with a mean QA score of 8 (range 8 to 8).

Carotid sinus hypersensitivity

- From the 6 studies that investigated carotid sinus hypersensitivity and falls, 3 reported a significant positive univariate relationship [90-92]. Of the studies that showed a significant relationship, the mean quality assessment score was 5.7 (range 5 to 6); for those showing no significant relationship [89, 93, 94] the mean score was 5.3 (range 5 to 6).
- Further, three interventional studies were identified examining the impact of pacemaker implantation on falls among adults aged ≥ 50 years with previous falls and cardioinhibitory carotid sinus hypersensitivity. In the first of these studies, paced individuals (treatment) were significantly less likely to fall compared to non-paced participants (control) over a 12-month period [95]. In the second of these studies, a cross over intervention, pacemaker implantation with the pacemaker turned on (treatment) did not have a significant effect on falls, when compared to pacemaker implantation with the pacemaker turned off (control).[96] In the third of these studies, there was no significant reduction in falls between those implanted with a pacemaker treatment), compared to an implantable loop recorder (control). However, there was a significant reduction in falls after device implantation compared to before for both groups- pacemaker and internal loop recorder [97].
- The quality assessment for each of these three studies (RoB2) resulted in "some concerns".
- Comment: Evidence for implantation of Pacemaker for Carotid Sinus hypersensitivity remains inconclusive.

Orthostatic hypotension

- From the 46 studies that investigated OH and falls, 19 reported a significant positive relationship (13 significant multivariate relationship [9, 17, 45, 69, 98-106], 6 significant univariate relationship [4, 76, 107-110]). Of the studies that showed a significant relationship, the mean quality assessment score was 6.4 (range 3 to 10); for those showing no significant relationship [16, 28, 41, 52, 61, 64, 66, 70, 71, 73, 76, 77, 79, 81, 82, 110-122] the mean score was 6.5 (3 to 9).
- From these 46 studies, OH was assessed using Beat-to-beat (BTB) measurement in 13 studies [4, 9, 64, 76, 98, 99, 102, 103, 107, 108, 110, 116, 123], an oscillometric sphygmomanometer in 13 studies [41, 45, 52, 70, 73, 77, 81, 112, 115, 116, 120, 121, 123], and an auscultatory sphygmomanometer in 8 studies [61, 66, 82, 100, 105, 114, 119, 122]. Eleven studies used sphygmomanometer but did not specify the type [69, 71, 79, 101, 104, 109-112, 117, 118]. The measurement instrument for OH was unspecified in 2 studies [16, 17].
- From the 13 studies utilising BTB, 10 reported a significant positive relationship (6 multivariate [9, 17, 98, 99, 102], 4 univariate [4, 107, 108, 110]), and 3 reported no significant relationship [28, 64, 76]. Of BTB studies showing a significant positive relationship, the mean QA score was 6.3 (range 3 to 9), while the studies reporting no significant relationship had a mean QA score of 7.3 (range 6 to 9).
- From the 13 studies utilising BTB, 8 were performed supine to standing [4, 17, 28, 98, 99, 102, 103, 108], 4 supine to tilted [9, 107, 110, 123], and 1 sitting to standing [64]. Of the 8 studies performed supine to standing 7 reported a significant positive relationship (5 significant multivariate relationship [17, 98, 99, 102, 103]; 2 significant univariate relationship [4, 108]). The mean quality assessment score of studies reporting a significant relationship was 6.9 (range 3 to 9); 9 for the study reporting no significant relationship [28]. Of the 4 studies performed supine to tilted 3 reported a significant relationship (1 significant multivariate relationship [9]; 2 significant univariate relationship [107, 110]). The mean quality assessment score of studies reporting a significant relationship was 5 (range 3 to 7); 7 for the study reporting no significant relationship [123]. The single study performed sitting to standing reported no significant relationship, with a quality assessment score of 6 [64].
- From the 13 studies utilising an oscillometric sphygmomanometer, 1 reported a significant positive multivariate relationship [45], with a mean QA score of 10; 1 a significant univariate relationship [123] with a quality assessment score of 7. 11 reported no significant relationship [41, 52, 70, 73, 77, 81, 113, 115, 116, 120, 121], and mean QA score was 7.5 (range 5 to 9).

- From the 8 studies using an auscultatory sphygmomanometer, 2 reported significant positive multivariate relationships [100, 105], and 6 did not report significant relationships [61, 66, 82, 114, 119, 122]. The mean QA score for studies with significant results was 6.5 (range 5 to 8). The mean QA score for studies that reported no significant relationship was 6.3 (range 3 to 9).
- From the 11 studies that used sphygmomanometers but did not report the specific type, 4 reported a significant positive relationship (3 multivariate [69, 101, 104], 1 univariate[109]), while another 7 reported no significant relationship [71, 79, 110, 111, 113, 117, 118]. Of the 4 studies reporting a significant relationship, the mean QA score was 5.5 (range 3 to 8); of those reporting no significant relationship, the mean QA score was 4.7 (range 3 to 8).
- From the 2 studies that did not specify the instrument used to measure OH, one reported a significant positive multivariate relationship [106] and had a QA score of 7, while the other reported no significant relationship [16], and had a QA score of 8.
- From the 32 studies utilising a sphygmomanometer, 23 were performed from supine to standing [41, 52, 66, 69, 70, 79, 82, 100, 101, 104, 105, 109, 110, 112-117, 119, 120, 122, 123], 2 supine to tilted [45, 81], and 4 sitting to standing [71, 77, 111, 118], 2 did not specify [61, 73], and one utilised an amalgamation of the above positions [121].
- Of the 23 studies performed supine to standing 7 reported a significant positive relationship (5 a significant multivariate relationship [69, 100, 101, 104, 105]; 2 a significant univariate relationship [109, 123]). The mean quality assessment score for studies reporting a significant positive relationship was 6 (range 3 to 8); 6.4 (range 3 to 9) for those reporting no significant relationship [41, 52, 66, 70, 79, 82, 110, 113-117, 119, 120, 122].
- Of the 2 studies performed supine to tilted 1 reported a significant relationship [45]. The quality assessment score for this study was 10; 9 for the study reporting no significant relationship [81].
- Of the 4 studies performed seated to standing, none reported a significant relationship [71, 77, 111, 118]. The mean quality assessment score for these studies was 5.3 (range 3 to 8).

PRACTICAL TIPS FOR RECOMMENDATIONS 1 AND 2

1. We recommend that a witness/collateral account is secured for all falls and that this occurs as close as possible, in time, to the fall event to determine whether or not transient loss of consciousness occurred.
2. We recommend that the cardiovascular assessment should incorporate details of blood pressure, heart rate and rhythm, and structural heart disease; therefore, cardiovascular tests should include a minimum of cardiac auscultation, orthostatic blood pressure measurement and surface electrocardiogram in older fallers.
3. Bradycardia or tachyarrhythmia can be captured with a surface electrocardiogram, telemetry or ambulatory heart rate monitoring – either by external loop recordings (if events are frequent) or internal loop recordings (for infrequent events). There is also an emerging role for the use of wearable devices over the coming years.
4. If rate or rhythm disorders are intermittent it is likely that abnormalities will not be captured by a single surface electrocardiogram or 24 hour monitoring and longer term monitoring, likely to capture a fall related rate or rhythm change, is required [23].
5. In many cases monitoring may be required over many months in which case an implantable monitoring device is preferred [124].
6. We recommend that if there is evidence of structural heart disease after auscultation or ECG an echocardiogram should be performed.
7. In frail older persons overall hypotension or post prandial hypotension may be associated with higher falls risk. New blood pressure targets are not consistently associated with falls unless individuals are frail.
8. 24-hour ambulatory blood pressure measurement will assist in the evaluation of overall blood pressure variability and in determining the time periods during which blood pressure is excessively low.
9. Another useful approach, to give the physician a more detailed overview of the older adult's BP response to activities of daily living, may be to advise the individual to perform BP measurements at standardised times

throughout the day, including pre and post meals, for a period of at least 2 weeks. We advise, where possible, to recreate the conditions that were associated with the fall.

10. Carotid sinus massage should be carried out, supine and upright, by a physician with experience in the technique (and all contraindications) and access to beat-to-beat blood pressure and heart rate monitoring and a tilt table (for conduct of upright CSM) and resuscitation equipment. Older adults with carotid artery obstruction/bruit, a recent stroke/TIA/myocardial infarction (all within 3 months) or an atrioventricular conduction abnormality should be excluded.
11. Where possible, beat-to-beat measurement of orthostatic blood pressure should be used to optimally detect an abnormal orthostatic response**.**
12. If frail older adults are unable to stand for measurements, head upright tilt on a tilt table may be used to assist with supine and upright blood pressure and heart rate recordings. Because head-up tilt testing excludes the muscle contractions associated with an active stand, the degree of hypotension may be exaggerated.
13. In some older adults, orthostatic hypotension and vasovagal syndrome may coexist in which case a more prolonged head up tilt test may aid in discriminating hypotension due to OH from that due to a diagnosis of VVS.
14. Oscillometric sphygmomanometer measurements should be taken from lying to standing where possible rather than sitting to standing for detection of OH and measured immediately after 5 minutes supine and at one-minute intervals thereafter during standing.

Working Group 3. Cardiovascular Risk Factors for Falls

RECOMMENDATION 4 (Interventions)
We recommend that management of orthostatic hypotension should be included as a component of multidomain intervention. **GRADE 1A.**

RECOMMENDATION 5 (Interventions)
We recommend that interventions for cardiovascular disorders identified during assessment for risk of falls should be the same as that for similar conditions when associated with syncope, in the addition to other interventions based on the multifactorial falls risk assessment. **GRADE 1B.**

RECOMMENDATION DETAILS

1. Whereas many multidomain fall prevention programmes have included strategies to treat orthostatic hypotension, including modification of possible culprit medications, rehydration, compression garments (elastic stocking and abdominal binders) and medications (e.g. fludrocortisone and midodrine), there are no single intervention studies for orthostatic hypotension in falls prevention [125-128]. However, a recent meta-analysis shows that orthostatic hypotension assessment/treatment is one of the effective components in reducing fall rate (in different combinations) of multidomain interventions [129].
2. In older adults with hypertension, symptoms may be ameliorated by the judicious use of antihypertensive medications titrated very slowly and with careful monitoring after changing the dose.
3. For the management of syncope, we advise following local syncope guidelines (e.g. European Cardiac Society Task force on Syncope [2]). Many multidomain fall prevention programmes that have shown benefit for fall prevention have included strategies to modify orthostatic blood pressure.
4. The presence of more than one cardiovascular risk factor for falls is not uncommon. Clear causality for a single risk factor may be difficult to establish; therefore, all modifiable cardiovascular risk factors should be treated.
5. There is a significant overlap between unexplained falls and syncope [6]. If unwitnessed falls are not due to slips or trips (i.e. are unexplained), it is possible that the individual experienced a syncopal event and displayed lack of awareness for LOC [7, 8]. Management of falls in such circumstances is the same as that for syncope [10, 11, 130].

6. Our recommendation aligns with the **2018 ESC Guidelines for the diagnosis and management of syncope,** which state that 'Despite the lack of controlled trials and an overall modest quality of studies, there is strong consensus that the management of unexplained falls should be the same as that for unexplained syncope.' [2].
7. Interventions for bradycardic disorders (sinus node disease, atrioventricular conduction disorders, vasovagal syndrome and carotid sinus syndrome) and tachyarrhythmias (atrial fibrillation, supraventricular and ventricular tachycardia) include modification of culprit medications specific anti-arrhythmic medication and, in some cases, implantable devices (such as pacemakers and implantable cardioverter-defibrillators) and are as per local syncope guidelines. Cardiac pacing treats bradycardia. One RCT of cardiac pacing in community-dwelling older people who had recurrent unexplained falls reported a significant reduction in fall rates at 12-month follow-up [131]. For the subset of older adults who meet the necessary diagnostic criteria, dual-chamber cardiac pacing for bradyarrhythmias (including carotid sinus hypersensitivity and conduction disorders) and treatment of tachyarrhythmia are components of a multidomain intervention designed to reduce the risk for falls.

PRACTICAL TIPS

1. Distribution of intake of possibly culprit medications throughout the day, rather than in a single dose, may reduce medication related falls.

OBJECTIVES FOR ALL RECOMMENDATIONS

The main goal of these recommendations is to assist health care professionals in the cardiovascular assessment and management of older adults who have fallen or are at risk of falling. **Note:** Because of dependence of the assessment on subsequent intervention for effectiveness, it was more difficult to ascribe strength of recommendation to assessment recommendations alone. Likewise, prior to any intervention, assessment of an individual's risks and deficits is required to determine specific needs and, if necessary, to deliver targeted interventions.

We present the recommendations for assessment and for intervention separately.

BACKGROUND

The most common cardiovascular disorders associated with falls are orthostatic hypotension, bradyarrhythmia (e.g. sick sinus syndrome and atrioventricular block), tachyarrhythmias (such as atrial tachycardia including atrial fibrillation and ventricular tachycardia), carotid sinus hypersensitivity and vasovagal syndrome. Three mechanisms have been proposed. The first is transient loss of consciousness with amnesia in which the older adult has no recollection of short episodes of syncope; this has been reported with orthostatic hypotension and carotid sinus hypersensitivity [68]. Given that many falls in older adults are not witnessed, these individuals may present with a report of a fall rather than syncope. A second proposed mechanism is that of transient hypotensive episodes, due to primary hypotension or hypotension secondary to arrhythmias, which cause a person with comorbid gait and balance instability to lose balance and fall without frank syncope. Finally, falls and cardiovascular disorders may share pathophysiological substrates, such as vascular damage to neural pathways governing gait and balance, thereby predisposing to falls.

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Working Group 4: Exercise and Physical Activity Interventions for the Prevention of Falls

RECOMMENDATION 1 (Interventions)
We recommend exercise programmes for fall prevention for community-dwelling older adults that include balance challenging and functional exercises (e.g. sit-to-stand, stepping) should be offered with sessions three times or more weekly which are individualised, progressed in intensity for at least 12 weeks and continued longer for greater effect. **GRADE 1A.**

RECOMMENDATION 2 (Interventions)
We recommend inclusion, when feasible, of Tai Chi and/or additional individualised progressive resistance strength training. **GRADE 1B.**

RECOMMENDATION DETAILS

1. The first recommendation applies to all older adults regardless of their assessed risk of falling or age
2. We recommend programmes that include balance and functional exercises (e.g. sit-to-stand, stepping) **GRADE: 1A**, programmes that include multicomponent exercise (i.e. multiple types of exercise), most commonly balance and functional exercises with strength exercise: **GRADE 1B**, and Tai Chi: **GRADE: 1**B.
3. Exercise programmes that need to be of sufficient intensity and duration should be delivered in a way that ensures safety and considers functional abilities.
4. Exercise programmes can be delivered in groups or individually.
5. Exercise programmes should be delivered by appropriately trained professionals who can adapt exercises appropriately to functional status and co-morbidities. These professionals could be physiotherapists, exercise physiologists or kinesiologists, trained exercise instructors or other allied health professionals. We acknowledge that this will be difficult in some settings but note that the vast majority of interventions found to be effective in trials used trained providers.
6. For the considerable other health benefits, older adults should aim to participate in 150-300 minutes per week of moderate-intensity physical activity or 75-150 minutes per week of vigorous-intensity physical activity and undertake resistance exercise. Varied multicomponent physical activity that targets functional balance and strength on three days per week is recommended to form part of weekly physical activity in order to enhance functional capacity and prevent falls [1].
7. Increasing physical activity outside of the delivered falls prevention exercise sessions should be encouraged and monitored. General physical activity alone (e.g. walking for errands) is unlikely to prevent falls.
8. Uptake and adherence to exercise interventions and to increasing habitual physical activity may be helped by behaviour-change approaches such as coaching, supervision, group activity and educational material.
9. Benefits of exercise are lost on cessation so opportunities to continue with appropriate activity at the end of the programme are important.
10. Higher supervision levels or smaller group numbers are recommended for those at higher risk of a fall including those who are frail. Contraindications to exercise should be considered when determining whether an exercise programme is appropriate for the individual.

RECOMMENDATION 3 (Interventions)
We recommend individualised supervised exercise as a falls prevention strategy for adults living in long-term care settings. **GRADE 1B.**

RECOMMENDATION DETAILS

1. Individual supervised exercises in care homes as a prevention strategy are effective and should be offered in those who are willing and able to participate. Programmes likely to be the most effective when individualised to residents' functional abilities and preferences, incorporate a combination of exercises including balance and strength, as well as environmental modifications and staff training in falls prevention.
2. Exercise as a single approach to falls prevention for care home residents is unlikely to reduce falls in older adults with or without cognitive impairment (GRADE 2A) but may have other benefits

3. Given the high level of disability in this group, where possible, an exercise specialist (physiotherapist, exercise physiologist) should be consulted to provide specialist, tailored advice on exercise and physical activity.

RECOMMENDATION 4 (Interventions)
We recommend that adults with Parkinson's Disease at an early to mid-stage and with mild or no cognitive impairment are offered individualised exercise programmes including balance and resistant training exercise. **GRADE: 1A.**

RECOMMENDATION DETAILS
1. We conditionally recommend supervised exercise for adults with mild to moderate Parkinson's disease as much as practicable by a suitably qualified professional, such as a physiotherapist or exercise physiologist, where available (**GRADE 2C**).
2. The effect of exercise on falls in older adults with Parkinson's disease that is more advanced (e.g. MDS-UPDRS motor score ≥ 34) and/or with substantial cognitive impairment is uncertain, but limited data indicate minimally supervised exercise may increase the risk of falls. Given the consequences of a potential increase in falls, we strongly recommend that exercise aiming to prevent falls in adults with Parkinson's disease that is more advanced (e.g. MDS-UPDRS motor score ≥ 34) and/or with substantial cognitive impairment is only conducted in a supervised setting (**GRADE 1C**). Supervision should be by a suitably qualified health professional, or a care-partner trained by a suitably qualified health professional) or as part of a research programme.
3. If exercise is provided for other health benefits, then it should be closely supervised, delivered by trained professionals and falls should be monitored.

RECOMMENDATION 5 (Interventions)
We conditionally recommend that older adults after a stroke should be offered participation in individualised exercise programmes aimed at improving balance/strength/walking to prevent falls. **GRADE 2C.**

RECOMMENDATION 6 (Interventions)
We recommend that older adults after sustaining a hip fracture should be offered an individualised and progressive exercise aimed at improving mobility (i.e. standing up, balance, walking, climbing stairs) as a fall prevention strategy. **GRADE: 1B.**

RECOMMENDATION 7 (Interventions)
We conditionally recommend that such programmes for older adults after a hip fracture are best commenced inhospitals **GRADE: 2C** and continued in the community **GRADE: 1A**.

RECOMMENDATION 8 (Interventions)
We recommend that community-dwelling older adults with cognitive impairment (mild cognitive impairment and mild to moderate dementia) should be offered an exercise programme to prevent falls. **GRADE: 1B.**

RECOMMENDATION DETAILS
1. Examples of effective stand-alone exercise interventions include balance training (e.g. Tai Chi) and multicomponent exercise (resistance + balance training).
2. In long-term care, exercise as a single approach, is unlikely to reduce falls in older adults with cognitive impairment (**GRADE: 2A**) but may have other benefits (see WHO guidelines [1]).
3. In settings like care homes those exercise should be delivered with co-supervision and special cuing.

PRACTICAL TIPS
1. Offering a choice of exercise types, setting, monitoring frequency, or supervision may improve uptake and adherence.

2. If individuals withdraw due to concurrent health issues or caring duties, they should be encouraged to return and programmes should be modified to ensure the difficulty level and dose are appropriate.
3. Liaison between health and fitness professionals will allow seamless exercise pathways across health and community settings for the individual and ensure effective type of exercise and dose.
4. When creating falls prevention care plans for older adults with cognitive impairment, both the older adult's and their caregiver's perspectives should be included as it improves adherence to interventions and outcomes.
5. Older adults (60 years or older) living in low- and middle-income countries (LMIC), should undertake regular physical activity and perform exercises to reduce their risk of falls. Evidence is lacking for culturally appropriate programmes for LMIC, and this should be a research priority

OBJECTIVE

Falls are commonly the result of interacting risks. Important risk factors are impaired balance and lower limb muscle weakness. The objective was to review the literature to assess if exercise (as a stand-alone intervention or in some reviews as part of a multiple domain intervention (e.g. cognitive impairment review) compared to usual care can prevent falls in older people: (i) living in the community; (ii) living in long-term care facilities; (iii) with Parkinson's disease; (iv) after stroke; (v) after hip fracture surgery and (vi) with cognitive impairment.

SUMMARY OF FINDINGS

These recommendations are informed by research evidence from meta-analyses and GRADE ratings. Evidence Profiles and related Evidence to Decision documents are provided in the supplementary materials.

The systematic reviews and meta-analyses used were:

- Update of the 2019 Cochrane review on exercise for falls prevention for community-dwelling older people [2].
- Update of the 2018 Cochrane review on falls prevention in long-term care settings [3].
- Cochrane reviews on falls prevention interventions in Parkinson's disease [4, 5].
- New analysis using data provided in the 2019 Cochrane review on interventions for preventing falls in people after stroke [6] and in 2 subsequent publications [7, 8].
- Updated Cochrane review on interventions for improving mobility after hip fracture surgery in adults, currently under review [9].
- New analysis using data from several systematic reviews on exercise interventions for falls prevention in older people with mild cognitive impairment to dementia [10-13].

JUSTIFICATION

These recommendations place a high value on preventing falls due to the risk of serious harm from falls. We also considered the additional health benefits (see WHO guidelines 2020 [1], minimal harms from being more active and likely cost-effectiveness of exercise interventions in determining the recommendations.

Community- dwelling older adults

The quality of evidence for exercise in preventing falls in older adults living in the community is high. Subgroup analysis suggests exercise is just as beneficial to those at higher and lower risk. However, most study participants have been white females, so evidence on uptake, adherence and effectiveness in males and people of diverse cultural and linguistic backgrounds and in low- and middle-income countries is more limited. The three most convincing forms of exercise (delivered as group or home-based programmes) are those classified as balance and functional training, Tai Chi, or multicomponent exercise (programmes that involve multiple exercise types, usually balance and functional exercise plus resistance exercise). Effective programmes are typically undertaken three times per week for at least 2 hours (weekly total). Trained individuals have led all effective interventions.

Long-term care facilities
The strength of evidence for exercise in preventing falls in older people living in long-term care facilities is very low. Supervision by trained professionals is necessary.

Parkinson's disease
The strength of evidence for exercise preventing falls in adults with mild to moderate Parkinson's disease and good cognition is high. We therefore conclude that the net benefit for these individuals with Parkinson's disease is high. Fully supervised exercise may have a greater effect on reducing falls. We are unsure if exercise increases fall rates in people with more advanced Parkinson's disease due to minimal evidence that is of very low certainty for this group. Supervision by trained professionals or a care-partner trained by a suitably qualified professional is necessary.

Stroke
The recommendation is based on systematic review evidence of health benefits of exercise aimed at improving strength/balance/walking in this clinical group [12].

Post hip fracture
The strength of evidence for exercise in preventing falls in older adults after hip fracture is moderate. There is some evidence (low certainty) that exercise may not reduce the risk of falls in adults with cognitive impairment post hip fracture.

Cognitive impairment
The certainty of evidence for exercise to prevent falls in older adults with cognitive impairment living in the community is moderate. Caregivers perceive exercise to be beneficial [13].

All older adults
The benefits of exercise cease when programmes are stopped and a person's risk returns to baseline, therefore it is also important to encourage changes in physical activity behaviour beyond the programmes sessions and opportunities to continue in appropriate activity after programmes cessation.

SUBGROUP AND SETTINGS CONSIDERATIONS
Community- dwelling older adults
The recommendations regarding exercise for falls prevention in community-dwelling older adults apply regardless of their assessed risk of falling or age. However, most studies excluded those with specific medical conditions that increased risk (e.g. Parkinson's disease, dementia) (see specific recommendations for these populations).

Long-term care facilities
In residents of long-term care facilities, exercise is unlikely to reduce falls in older adults with cognitive impairment, but the wider benefits of exercise to this population must be considered.

Parkinson's disease
There is a subgroup difference between fully supervised and less than fully supervised exercise, where fully supervised exercise may reduce fall rates by 44% (equivalent to 3,630 fewer falls per year per 1,000 people with Parkinson's disease who undertake an exercise programme) and less than fully supervised exercise probably reduces fall rates by 15% (equivalent to 1,238 fewer falls per year per 1,000 people with Parkinson's disease who undertake an exercise programmes). However, in adults with advanced disease there is very low certainty evidence that minimally supervised exercise may substantially increase the rate of falls. Increased supervision may decrease this risk to offset against the other benefits of exercise. There are no studies including participants with Parkinson's disease and cognitive impairment (MMSE < 24/30).

Post hip fracture
Post hip fracture, it is uncertain if exercise reduces falls in older adults with cognitive impairment, but the wider benefits of exercise to this population must be considered.

Stroke
There has been very little research on exercise in acute settings, previous studies were mostly in community settings with adults in the chronic stage. Higher supervision is warranted when there are more impairments following stroke.

Cognitive impairment
While residents of long-term care facilities tended to have lower cognitive ability (in 3 out of 4 studies, scores for cognitive ability were lower than most scores reported in the cohorts from the community setting), there are many other factors that may differ between the two settings and the people residing in the two settings. The small number of studies prevents us from making recommendations with regards to effectiveness of falls prevention exercise relative to level of cognitive impairment.

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS
Toolkits available to help maintain fidelity to original interventions or to improve quality of provision for 'real world' implementation and scale-up include the US CDC's compendium of effective interventions (such as the Otago Exercise Programmes, https://www.cdc.gov/falls/programmes/compendium.html) and the implementation manual for commissioners of services wanting to implement the FaME group programme (https://arc-em.nihr.ac.uk/clahrcs-store/falls-management-exercise-fame-implementation-toolkit). The vivifrail toolkit provides useful guidance on exercise prescription and is available in multiple languages: http://vivifrail.com/. Websites giving evidence-based advice to older adults about home exercise have been developed by physiotherapists in Australia https://www.safeexerciseathome.org.au/ and the USA https://www.homestrong.net/.
To maximise the uptake of interventions and ongoing adherence to programmes, older adults should be encouraged to choose their preferred supervision and monitoring level, setting and exercise type (within balance and functional exercises, multicomponent exercise, or Tai Chi). Exercise should not be primarily seated and should encourage safe standing balance challenge. Training programmes for providers should account for their level of expertise and the type of client they work with (e.g. frailer, highly co-morbid adults versus lower falls risk older adults in the community). This will ensure providers have the appropriate expertise in effective exercise prescription/delivery for their context. The overall cost and the cost-effectiveness of the programmes vary depending on the effectiveness of the intervention, the primary type of exercise chosen, the use of equipment, the location of the programme, number of participants per group, the person delivering the programmes, amount of supervision and contact for safety and adherence, and the frequency of follow up on participants' progression. Systems to make exercise options affordable and widely available are required. Programmes to be implemented for older adults with cognitive impairment and post hip fracture can be home-based or group-based but appear to have better adherence if more closely supervised. In adults with mild to moderate Parkinson's disease, programmes that include an exercise class taught by a health professional supplemented with home-based training are likely to be more cost effective.

MONITORING AND EVALUATION
Falls and injury rate, amount and type of physical activity participation as well as health conditions, disease severity and dementia sub-types if applicable, should be monitored through national surveys and audits.

RESEARCH PRIORITIES
Community- dwelling older adults
Balance and functional exercises decrease risk of falls. Some older adults and providers may prefer different types of exercise that are yet to be well investigated. We need further high-quality evidence on: strength training as a single exercise intervention or its added value to challenging balance and functional exercises; walking

exercise programmes; other physical activities/exercise such as yoga, dance, Pilates, sports, and hydrotherapy; task-specific perturbation and stepping training, cognitive/motor training; adverse events; effectiveness of behavioural change strategies (e.g. goal setting) to enhance exercise uptake and adherence; uptake, adherence, and effectiveness of exercise in males, low- and middle-income countries and in culturally and linguistically diverse and socioeconomically disadvantaged communities; optimal ways to implement programmes into practice in a range of settings.

Long-term care facilities, Parkinson's disease, post hip fracture, stroke, cognitive impairment
There is a need for more trials adequately powered for falls and injuries exploring aspects of exercise programme design (type, e.g. primarily standing exercise rather than seated, intensity, dose, supervision). Trials should also examine effects on other health outcomes including mood, physical function, mobility, and quality of life. There is a particular need for studies (i) in those with diagnosed cognitive impairments (disease sub-types, degree); (ii) in those at different stages of impairment (e.g. stroke acuity, Parkinson's disease severity and sub-types e.g. with freezing), (iii) undertaken in hospital settings iv) ongoing exercise after discharge from hospitals into the community (e.g. after hip fracture).

Older adults not covered by other specialised recommendations
We need more evidence on the long-term effects of exercise and pattern and timing of deconditioning after interventions stop. We need further robust cost-effectiveness studies across settings and health conditions. We need guidelines for conducting cost-effectiveness analysis in this area to allow comparison of studies. We need studies investigating the effect of commencing participation in balance and strength exercises in midlife on falls and fall-related injuries in older age. Trials need to be conducted in a range of countries with differing aged care systems, care levels and funding models.

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Working Group 5: Falls in Hospitals and Care homes

RECOMMENDATION 1 (Hospitals Assessment)
We conditionally recommend performing a multifactorial falls risk assessment in all hospitalised older adults >65 years of age. We recommend against using scored falls risk screening tools in hospitals for multifactorial falls assessment in older adults. **GRADE 2B.**

RECOMMENDATION DETAILS
A multidisciplinary team member with appropriate skills and experience on falls prevention should perform a multifactorial falls assessment for older adults after admission into an acute care setting.

PRACTICAL TIPS
A multifactorial falls assessment may include the following [1]:

- identification of falls history
- assessment of gait, balance and mobility, physical activity, strength, and muscle weakness
- assessment of osteoporosis
- assessment of fracture risk
- assessment of perceived functional ability and fear of falling
- assessment of visual impairment and sensory loss
- assessment of cognitive impairment, including delirium and dementia
- neurological examination
- assessment of urinary incontinence
- cardiovascular examination and medical review.

OBJECTIVE
To review the literature to assess the effectiveness of multifactorial falls risk assessment and scored falls risk screening tools to prevent falls in hospitalised older adults.

SUMMARY OF FINDINGS

1. A systematic review and meta-analysis of scored falls risk screening tools in hospitals (n=35 studies) showed that using clinical judgement to classify an older adult as 'high risk for falls' is as good as using a screening tool in the acute hospital setting. Fall risk screening tools are not optimal for identifying individuals with an elevated risk of falling or injuries in hospitals [1].
2. A cluster RCT in 10 Australian hospitals evaluated a best practice model for reducing hospital falls that incorporates the United Kingdom “NICE” clinical guideline [2] to cease using a traditional scored fall risk prediction tool for all older adults aged 65 years or older and adults aged 50-64 years who a clinician judges to be at higher risk of falling because of an underlying condition. For the control group hospitals, fall risk screening tools to detect individuals at high falls risk continued as usual. The fall risk screening tool component and associated summary scores and numerical risk ratings were removed for the experimental group hospitals. The experimental condition (no fall risk screening score) was not inferior to the control condition (fall risk screening score) for reducing falls in hospitals [3].
3. A stepped-wedge, cluster-RCT investigating the impact of removing a falls risk screening tool from an overall falls risk assessment programme found no impact on the falls rate [4].
4. A systematic review and meta-analysis of seventeen studies undertaken to determine the overall diagnostic accuracy of the STRATIFY (a clinical prediction rule derived to assist clinicians in identifying individuals at risk of falling) showed that the diagnostic accuracy of the STRATIFY rule is limited and should not be used in isolation for identifying individuals at high risk of falls in clinical practice [5].
5. A Cochrane review [6] of 24 RCTs (97,790 participants; mean age 78 years; 52% women) found that multifactorial falls risk assessment, followed by implementation of multidomain interventions, may reduce the rate of falls in hospitals (RR=0.80, 95% CI 0.64 to 1.01; 44,664 participants, five studies).

JUSTIFICATION

Falls risk screening tools and multifactorial falls risk assessments are sometimes used interchangeably, but there are substantial differences. There is a case for dis-investing from fall risk screening tool scoring in the hospital setting as it does not reduce falls and takes valuable time. Falls risk assessment is a more detailed process used to identify underlying risk factors and inform the development of a care plan to reduce falls and injuries.

SUBGROUP AND SETTINGS CONSIDERATIONS

Younger individuals (aged 55-64 years) with neurological disorders, stroke, cognitive impairment/delirium, hip fractures, or anyone that clinicians have judged as 'at risk' of falls should also undergo a multifactorial falls assessment.

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS

1. Highlight that a conversation about multifactorial falls assessment should occur between health professionals, older adults, and their families at admission.
2. Falls assessments should be completed as soon as practical following admission.
3. Falls risk assessments should be reviewed if there is a change in an individual's condition or if the older adult falls.
4. The results of multifactorial falls assessments need to be documented and recorded.
5. The multifactorial falls risk assessment should inform implementation of falls prevention strategies (see Recommendation 3) and be used to formulate the individual care plan.
6. Clinical reasoning/judgment should be considered when deciding which falls prevention interventions to implement.

MONITORING AND EVALUATION

Processes to ensure multifactorial falls risk assessments are being completed promptly and accurately (e.g. regular audits) should be conducted.

RESEARCH PRIORITIES

More research is needed to evaluate the effectiveness of multifactorial falls risk assessment tools. Research into strategies to support the implementation of multifactorial falls risk assessments should also be conducted.

Working Group 5: Falls in Hospitals and Care homes

RECOMMENDATION 2 (Hospitals Assessment)

We recommend conducting a post-fall assessment in hospitalised older adults following a fall in order to identify the mechanism of the fall, any resulting injuries, any precipitating factors (such as new intercurrent illness, complications or delirium), to reassess the individual's fall risk factors, and adjust the intervention strategy for the hospitalised older adult. **GRADE: E**.

Working Group 5: Falls in Hospitals and Care homes

RECOMMENDATION 1 (Hospitals Management and Interventions)

We recommend that a tailored education on falls prevention should be delivered to all hospitalised older adults (≥ 65 years of age) and other high-risk groups. **GRADE 1A.**

RECOMMENDATION DETAILS

When well-designed education programmes are implemented, they can improve knowledge and self-perception of risk, empowering older adults to reduce their risk of falling in hospital [1]. The individual's cognitive status (i.e. delirium or dementia) should be considered when implementing the education programmes.

PRACTICAL TIP

This should be part of a multidomain intervention. Varied modes of delivery can be utilised (e.g. face-to-face discussions, handouts, videotapes).

OBJECTIVE

To review the literature to assess whether education (alone or in conjunction with other falls prevention interventions) effectively reduces falls and determine what modes of education are most feasible.

SUMMARY OF FINDINGS

1. There is emerging evidence that hospital falls prevention interventions incorporating older adult education can reduce falls and associated injuries such as bruising, lacerations or fractures [7, 8]. The design, delivery mode, and educational design quality influence outcomes. Well-designed education programmes can improve knowledge and self-perception of risk, empowering older adults to reduce their risk of hospital falls [9, 10].
2. Falls prevention programmes that contained older adult education effectively reduced fall rates amongst hospital inpatients (and reduced the proportion of individuals who became fallers in hospital). Older adult education generally increased knowledge about falls and awareness of prevention strategies. The uptake of strategies may depend on the targeted activities [8-10].
3. Individualised education programmes combined with training and feedback to staff added to usual care reduce the rates of falls and injurious falls in older adults in rehabilitation hospital units [8-10].

JUSTIFICATION

Some hospitalised older adults initiate risky decisions about mobility based on their own judgements without always seeking help from nurses or other health professionals. This could be due to a lack of knowledge or behavioural symptoms of delirium and dementia. Education is one strategy to address this, as it assists older adults in self-manage their own falls risk by increasing a person's awareness of their own falls risk and providing them with strategies to mitigate falls whilst hospitalised. Education is usually delivered in conjunction with other strategies.

SUBGROUP AND SETTINGS CONSIDERATIONS

This recommendation may not be relevant for people with cognitive impairment, but it may be appropriate for their family members/carers [8-10].

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS

Education should be extended to all hospitalised adults if resources permit.

A range of multimodal strategies can be utilised to deliver education, e.g. pamphlets, videos, verbal conversations

The use of interpreters should be considered when providing education to people from cultural and linguistically diverse backgrounds.

MONITORING AND EVALUATION

Strategies to evaluate the impact of education packages should be considered, including individuals preference for mode of education (written vs video vs verbal).

RESEARCH PRIORITIES

More research is needed to investigate new and innovative implementation strategies and health literacy techniques to provide education (e.g. Teach-back).

Working Group 5: Falls in Hospitals and Care homes

RECOMMENDATION 2 (Hospitals Management and Interventions)

We recommend that personalised single or multidomain falls prevention strategies based on identified risk factors or behaviours or situations should be implemented for all hospitalised older adults (≥ 65 years of age), or younger individuals identified by the health professionals as at risk of falls. **GRADE 1C (Acute care), GRADE 1B (Sub-acute care).**

RECOMMENDATION DETAILS

1. This should include considering strategies informed by findings from a multifactorial falls risk assessment. There is currently no robust research evidence to recommend the use of (i) bed/chair alarms, (ii) grip socks/non-slip socks for the purpose of falls prevention and (iii) the use of physical restraints when the sole purpose is falls prevention in hospitals.
2. We recommend that all hospitals should have protocols, policies and/or procedures for the prevention of falls consistent with best practice guidelines [11-14] .

PRACTICAL TIPS

1. Conversations and interventions to prevent falls should start from the day of hospital admission.
2. Environmental strategies such as reducing clutter, ensuring call bells are within reach, ensuring adequate lighting, use of glasses, and access to appropriate walking assistive devices should also be implemented for all adults in hospital

OBJECTIVE

To review the literature to evaluate the effectiveness of falls prevention interventions on reducing falls in hospitalised older adults.

SUMMARY OF FINDINGS

1. A Cochrane review of 24 RCTs (97,790 participants; mean age 78 years; 52% women) found that a multifactorial falls risk assessment, followed by implementation of multidomain interventions, may reduce the rate of falls in hospitals (RR=0.80, 95% CI 0.64 to 1.01; 44,664 participants, five studies), but the very low-quality evidence precluded a definite conclusion. A subgroup analysis by setting suggests the reduction may be more likely in a subacute setting (RR=0.67, 95% CI 0.54 to 0.83; 3747 participants, two studies; low-quality evidence). We are uncertain of the effect of multidomain interventions on the risk of falling (RR=0.82, 95% CI 0.62 to 1.09; 39,889 participants; 3 studies; very low-quality evidence) [6].
2. A meta-analysis of interventions to reduce hospital falls [7] showed that older adults and health professional education could be beneficial. Multidomain interventions also showed a tendency to reduce hospital falls.
3. A systematic review of seven RCTs suggested that implementing a multidisciplinary multidomain intervention that consists of systematic assessment and treatment of fall risk factors, as well as active management of postoperative complications, can reduce the number of falls in older adults following surgery for femoral neck fracture [15].
4. There is evidence that multicomponent non-pharmacological delirium prevention interventions effectively reduce delirium incidence and prevent falls, with a trend toward decreasing length of stay and avoiding institutionalization [16].
5. Equipment such as the use of bed and chair alarms for the sole purpose of falls prevention, are expensive, and evidence from randomised controlled trials does not support their use as a single intervention approach for falls prevention in hospitals [7, 17].
6. There is no evidence to support the used of grip socks [18] or physical restraints [19].

JUSTIFICATION

Developing and implementing a tailored falls prevention plan of care based on the findings of a multifactorial falls risk assessment may reduce falls in hospitals and their associated consequences: including deterioration of older adult physical function due to fall-related injuries, social isolation, anxiety and depression, impaired rehabilitation, more extended hospital stays and incapacity to return home, as well as increased health and social care costs.

SUBGROUP AND SETTINGS CONSIDERATIONS

Falls prevention interventions for older adults with cognitive impairment and/or at high risk of delirium should be implemented in consultation with the older adult and their family members/carers.

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS

Falls prevention interventions should adjust to the local resources and budget. Most multifactorial falls prevention programmes are cost-effective but require time and dedication by local staff, which is not always available in organisations with staff shortages or limited resources. Caregivers and family members can also support the falls prevention programme.

MONITORING AND EVALUATION

Interventions should be monitored regularly to ensure they are implemented as intended and effectively prevent falls.

RESEARCH PRIORITIES

Further studies are warranted to develop/evaluate effective falls prevention interventions that reduce falls in hospitalised older adults, including those with cognitive impairment.

Working Group 5: Falls in Hospitals and Care homes

RECOMMENDATION 1 (Care Home Assessment)
We recommend against falls risk screening to identify care home residents at risk for falls, since all residents should be considered at high risk of falls. **GRADE 1A.**

RECOMMENDATION DETAILS
All care home residents have a high-risk of falling and can benefit from a multifactorial fall risk assessment and tailored intervention strategy.

PRACTICAL TIPS
For practical tips, please see "implementation considerations and toolkits" below.

OBJECTIVE
Care home residents have an increased risk of falling due to physical frailty and/or cognitive decline [20]. Hence, they would all benefit from a multifactorial falls risk assessment and tailored interventions. However, this approach is time and resource-intensive and therefore not always feasible in routine practice. By identifying residents at the highest risk, a multifactorial falls risk assessment and tailored interventions can be offered to those who could benefit most from it [21]. The objective was to review the literature to assess what falls risk screening tool or process should be performed in care homes to identify residents with increased fall risk.

SUMMARY OF FINDINGS
1. Six systematic reviews evaluated fall risk screening tools in care homes. Lee et al. (2013) and Da Costa et al. (2012) found that no screening tool had a good balance of sensitivity and specificity to qualify as a risk estimation tool [22, 23]. Perell et al. (2001) concluded that the time, even as short as it is to complete screening tools, may be better utilised to implement an overall fall prevention programme rather than screening individuals because the vast majority of older adults in the extended care settings may be deemed high risk [24]. Kehinde (2009) stated that the lack of consistency in the literature regarding the use of fall risk assessment in long-term care settings and the uniqueness of the environment demands a critical analysis of fall risk instruments that is specific to older adults living in long-term care facilities [25]. Scott et al. (2007) concluded that few tools were found that were tested more than once or in more than one setting [26]; therefore, no single tool could be recommended for use in all settings or all subpopulations within a setting. And last, Nunan et al. (2018) [21] states that evidence for the best choice of screening tools for use in LTC remains limited. Further research is warranted before establishing a tool of choice for care homes.
2. Several clinical practice guidelines recommend against falls risk screening to identify care home residents at risk for falls because all care home residents have a high risk [27, 28]. In addition, the Cochrane collaboration review stated that "the use of a falls risk-assessment tool in comparison with nurses' judgement alone probably makes little or no difference to the rate of falls or risk of falling" (analysis 8.1.3: RaR 0.96, 95% CI 0.84 to 1.10; Analysis 8.2: RR 0.99, 95% CI 0.85 to 1.16; both outcomes moderate-quality evidence, downgraded one level for risk of bias) [6].
3. One prospective multicentre cohort study evaluated and compared the predictive validity relative to falls of the Timed Up-and-Go test (TUG), a modified Get-Up-and-Go test (GUG-m), staff's judgement of global rating of fall risk (GLORF) and fall history in nursing homes [29]. Staff judgment of their residents' fall risk and previous falls, both appear superior to the performance-based measures TUG and GUG-m in ruling in high fall risk. A TUG score of less than 15 s gives guidance in ruling out a high fall risk, but this information is insufficient in ruling in such a risk.
4. Another prospective multicentre cohort study compared the predictive accuracy of fall history, staff clinical judgment, the Care Home Falls Screen (CaHFRiS), and the Fall Risk Classification Algorithm (FRiCA). Fall history, followed by the FRiCA and the CaHFRiS, showed the best sensitivity and negative predictive value,

two crucial aspects for appropriate screening. However, considering their moderate predictive accuracy, no recommendations can be made for using any of these methods in care homes.[30]
5. Several observational studies evaluated different screening tools; however, the psychometric properties of the different screening methods were moderate at best [31-33].

JUSTIFICATION
There is often confusion between the terms "fall risk screening" and "fall risk assessment" in literature. Screening can be defined as "a process that primarily aims to identify people at increased risk of falls," whereas assessment can be described as "a process that aims to identify factors that increase the risk of a fall that can be dealt with by subsequent interventions." [20]. There is no evidence that falls risk screening can successfully identify care home residents at risk for falls. And because almost all residents have an increased risk of falling and therefore almost all would benefit from a multifactorial falls risk assessment for fall prevention, staff should invest their scarce time in multifactorial falls risk assessments and multidomain interventions instead of screening, starting with residents who have a fall history [30].

SUBGROUP AND SETTINGS CONSIDERATIONS
Not applicable.

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS
Not applicable.

MONITORING AND EVALUATION
Not applicable.

RESEARCH PRIORITIES
Because current methods have insufficient psychometric properties to predict falls among residents, there is an urgent need for accurate tools. Future studies should focus on developing and evaluating innovative smart technologies (e.g. AI, wearables) in care homes. In addition, many screening tools are being developed, but too few are validated in different settings, especially care homes.

Working Group 5: Falls in Hospitals and Care homes

RECOMMENDATION 2 (Care Home Assessment)
We recommend performing a multifactorial falls risk assessment at admission to identify factors contributing to fall risk and implementing appropriate interventions to avoid falls and fall-related injuries in care home older adults. **GRADE 1C.**

RECOMMENDATION DETAILS
1. This should include follow-up measures in all care home residents, taking into account a person-centred approach.
2. All care home residents have a high risk of falling and may benefit from a multifactorial falls risk assessment and tailored intervention strategy.
3. A multifactorial falls risk assessment at admission should include identifying falls risk factors and be repeated at least once annually or when the resident's condition changes, based on resource availability in each setting.

PRACTICAL TIPS
For practical tips, please see "implementation considerations and toolkits" below.

OBJECTIVE

The objective was to review the literature to evaluate the effectiveness of falls prevention assessment and interventions on reducing the rate and risk of falling in care homes.

SUMMARY OF FINDINGS

1. Several reviews evaluated the effectiveness of fall prevention interventions on reducing falls in care home residents. Cameron et al. (2018) [6] were uncertain of the effect of multidomain interventions on the rate of falls; they may make little or no difference to the risk of falling. One other meta-analysis in a clearly described subgroup of care homes defined as residential facilities that provide 24-hour-a-day surveillance, personal care, and limited clinical care for persons who are typically elderly and infirm failed to reveal a significant effect of fall prevention interventions on falls or fallers but, showed that fall prevention interventions significantly reduced the number of recurrent fallers by 21% [34]. A recent systematic review and meta-analysis, which defined residential facilities as facilities that provide 24-hours-a-day surveillance, personal care, and some clinical care for adults who are typically aged ≥65 years with multiple complex chronic health conditions, found that multidomain interventions reduce the number of falls (RR = 0.65, 95% CI = 0.45-0.94) [35].
2. A recent large scale randomised controlled trial with over 1,600 care home residents demonstrated that a multidomain intervention was both efficacious in reducing falls at 91-180 days and also cost-effective in long-term care homes. However, the effect was not sustained at study endpoints beyond 180 days after randomization [36].
3. Most clinical practice guidelines recommend a multifactorial falls risk assessment and multidomain interventions in care homes [27, 28, 37].

JUSTIFICATION

Whilst there is a lack of firm evidence that a multifactorial falls risk assessment and multidomain intervention can successfully reduce the rate and risk of falling in care homes, incorporating such a multifactorial falls risk assessment and multidomain intervention, where appropriate, is warranted.

SUBGROUP AND SETTINGS CONSIDERATIONS

Falls prevention interventions for residents with cognitive impairment should be implemented in consultation with the resident and his family members/caregivers.

For palliative care residents, recommendation 2 is not endorsed.

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS

1. Successful implementation of fall prevention depends on many factors across different healthcare levels. Interventions that assess and "take account of the care home context and which empower care home staff and organisations as partners in design and implementation" seem needed [36].
2. The focus of implementation interventions should be on modifiable barriers and facilitators such as communication, knowledge, and skills. Effective fall prevention must consist of multidomain interventions that target each resident's fall risk profile and should be tailored to overcome context-specific barriers and put into action the identified facilitators [38].
3. Development of supporting structured tools, such as an implementation plan for fall prevention, could potentially improve the implementation of fall prevention assessment and intervention strategies [39].
4. Fall prevention interventions need to incorporate the older adult's beliefs and attitudes towards falls and their management when developing an agreed care plan with them and/or their caregivers.
    - "Guide to Action Care Home" (GtACH) Tool [36, 40, 41].
    - Logan et al. (2022) [42] confirmed that an intervention which includes awareness-raising, education, decision, and implementation support could be a cost-effective way to reduce fall rate in care homes without decreasing activity of increasing dependency in residents. The authors state that it is possible that the intervention succeeded because of its comprehensiveness, the empowerment and recognition of the pivotal role played by care home staff in designing, implementing, and delivering the programme.

"Evidence Booster: Best Practice Guideline Implementation and Estimated Cost Savings", RNAO, https://rnao.ca/bpg/resources/evidence-booster-best-practice-guideline-implementation-and-estimated-cost-savings

- "Evidence Booster: Best Practice Guideline Implementation to Reduce Falls in Older Adults", RNAO, https://rnao.ca/bpg/resources/evidence-booster-best-practice-guideline-implementation-reduce-falls-older-adults
- Evaluation of the Guide to Action Care Home fall prevention programmes in care homes for older people: protocol for a multicentre, single-blinded, cluster randomised controlled trial (FinCH), https://www.nottingham.ac.uk/emran/documents/issue-25-emran-feb-2019.pdf

MONITORING AND EVALUATION

We recommend performing a multifactorial falls risk assessment at admission to identify factors contributing to fall risk and determine appropriate interventions and follow-up measures to avoid falls and fall-related injuries. This assessment should be repeated at least once annually or when the residents' condition changes and based on resource availability in each setting.

RESEARCH PRIORITIES

More research on fall prevention interventions in care home is needed that include people with cognitive impairment and dementia is to improve the generalizability of these interventions to the typical care home resident [35]. In addition, successful implementation, and sustainability of fall prevention interventions over time should be further investigated [36].

Working Group 5: Falls in Hospitals and Care homes

RECOMMENDATION 3 (Care home Assessment)

We recommend conducting a post-fall assessment in care home residents following a fall in order to identify the mechanism of the fall, any resulting injuries, to reassess the resident's fall risk factors, adjust the intervention strategy for the resident and avoid unnecessary transfer to acute care. **GRADE E (expert consensus).**

RECOMMENDATION DETAILS

After a person falls, provide the following interventions [37]:

1. Conduct a physical examination to assess for injury & to determine the severity of any fall injuries
2. Provide appropriate treatment and care; and monitor for injuries that may not be immediately apparent
3. Conduct a post-fall assessment to determine factors that contributed to the fall and collaborate with the resident & the interprofessional team to conduct further assessments & determine appropriate interventions

➔ *See Recommendation 2 (Care Home Assessment)*

PRACTICAL TIPS

For practical tips, please see "implementation considerations and toolkits" below.

OBJECTIVE

The objective was to review the literature to assess what interventions or processes should occur immediately following a fall in care home residents.

SUMMARY OF FINDINGS

1. Two guidelines [27, 37] and an Cluster RCT by Jensen et al. (2002) recommend conducting a post-fall assessment as a comprehensive response is required following a fall. According to the expert panels

developing the RNAO & EVV guidelines, post-fall processes can reduce the negative consequences of falls, inform interventions to prevent or reduce future falls, and lead to quality improvement for healthcare organisations.

2. Beauchet et al. (2011) [43] recommend systematically assessing the severity of fall injuries. For those who have been unable to get off the floor and have been resting on the ground for a prolonged period (e.g. over an hour), healthcare providers should assess for consequences such as hypothermia, pressure injuries, and dehydration.
3. Following an assessment, and if it is safe to do so, the resident can be carefully assisted off the floor (with transfer equipment, if available). Older adults should be assessed and treated for complications resulting from the fall, such as reduced physical function, psychological side-effects (including fear of falling), or changes in cognition [43]. Following treatment for injury, healthcare providers should follow organisational procedures such as documentation, informing family, and completing incident reports.
4. Some injuries may not be apparent immediately following a fall. In some cases, close observation of emerging injuries may be prudent (e.g. if a head injury is suspected). Examples that may not be immediately apparent include soft tissue injuries or subdural hematoma. Further research is needed in this area to determine appropriate post-fall monitoring. Each care home should determine protocols for monitoring emerging injuries [37].
5. A post-fall assessment is used to determine factors that contributed to the fall and inform strategies to prevent future falls. This can help prevent both the same and other residents from falling in the future (e.g. if the assessment determines root causes that may require systemic changes within the care home). Acute medical conditions (e.g. syncope, hypoglycaemia, stroke, heart failure, infections as urinary, respiratory or bacteraemia, hidden or not) that may have precipitated a fall should be investigated and treated. Other precipitating factors may include the resident's actions at the time of the fall (e.g. rushing) or environmental conditions (e.g. slippery floor) [44]. A post-fall assessment can help identify underlying causes and contributing factors that are not always obvious. Family members or others present at the time of a fall may also provide essential insights. A post-fall huddle which the interprofessional team may be an effective approach to understanding the factors contributing to a fall.
6. Following a fall, the resident should be offered an assessment to address future falls risk and implement or adjust interventions to address falls risk [45].

JUSTIFICATION

Although there is little evidence for this recommendation, the working group considered this an important recommendation based on expert consensus.

SUBGROUP AND SETTINGS CONSIDERATIONS

Not applicable.

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS

1. AHRQ (Agency for Healthcare Research and Quality). The Falls Management Programme: A Quality Improvement Initiative for Nursing Facilities: Chapter 2 Fall response. https://www.ahrq.gov/patient-safety/settings/long-term-care/resource/injuries/fallspx/man2.html
2. "Evidence Booster: Best Practice Guideline Implementation and Estimated Cost Savings", RNAO, https://rnao.ca/bpg/resources/evidence-booster-best-practice-guideline-implementation-and-estimated-cost-savings
3. Examples of post-fall assessments:
    - "Falls Debriefing and Action Plan from St. Joseph's Healthcare Hamilton (Ontario, Canada)." (RNAO, 2017. Appendix J.)
    - "Post fall protocol for Hampshire County Council Adult Services (NHS England)." https://www.nhs.uk/NHSEngland/keogh-review/Documents/quick-guides/background-docs/4-Hampshire%20falls%20protocol.pdf

4. Post fall multidisciplinary management guidelines for Western Australian Health Care Settings, 2018. https://www.osrecruitment.health.wa.gov.au/-/media/Files/Corporate/general-documents/Health-Networks/Falls-prevention/WA-Post-Fall-Guidelines_Final_2018_PDF.pdf

MONITORING AND EVALUATION

A post-fall assessment should be provided after every fall incident in order to avoid unnecessary transfer to acute care following a fall in care home residents.

RESEARCH PRIORITIES

More research is needed regarding the exact content of such a post-fall assessment.

Working Group 5: Falls in Hospitals and Care homes

RECOMMENDATION 1 (Care Homes Management and Interventions).

We recommend a multifaceted approach to falls reduction for care home residents including care home staff training, systematic use of a multidomain decision support tool and implementation of falls prevention actions. **GRADE 1B.**

RECOMMENDATION 2 (Care Homes Management and Interventions)

We recommend against the use of physical restraints as a measure for falls prevention in care homes. **GRADE 1B.**

RECOMMENDATION DETAILS

1. The effectiveness of the multifaceted approach is based on one recent RCT.[42] The focus of implementation interventions should be on modifiable barriers and facilitators such as communication, knowledge and skills.

2. Examples of physical restraint devices that should be avoided for the purpose of falls prevention include lap belts, bed rails, Posey restraints or similar, chairs with tables attached, and chairs or mattresses that are difficult to get out of such as recliner chairs, water chairs, bean bags and curved edge mattresses. Use of some of these items may be justified for other well-defined purposes, subject to careful assessment and review and when agreed with the resident or their advocates.

PRACTICAL TIPS

For practical tips, please see “implementation considerations and toolkits” below.

OBJECTIVE

The objective was to review the literature to assess if physical restraints should be used as a measure for falls prevention in care home residents.

SUMMARY OF FINDINGS

1. The systematic review of Sze and colleagues (2012) [19] showed in nine observational studies in care homes or hospitals that physical restraints did not reduce falls and that decreased usage of restraints did not result in more fall incidents. Therefore, the authors concluded that physical restraints do not reduce falls or injuries among care home residents.

2. A recent systematic review and meta-analysis of experimental studies evaluated the effectiveness of interventions to reduce physical restraint use in care homes residents [46]. They included different important studies such as the EXBELT intervention[47], the cluster-randomised trial of Huizing et al. (2009) [48], and the randomised controlled trial by Köpke et al. (2012) [49]. Their findings underline that educational training and multicomponent programmes could effectively reduce the use of physical restraints in care home settings. However, many of the individual studies (8 studies reported on falls and injuries related falls outcomes; five studies included in the meta-analysis) included in this review showed decreased usage of restraint did not result in more fall incidents.
3. Most clinical practice guidelines recommend against the use of physical restraints as a measure for falls prevention in care homes [27, 37].

JUSTIFICATION

Based on the evidence, the working group considered this an important issue and recommends against the use of physical restraints as a measure for falls prevention in care homes.

SUBGROUP AND SETTINGS CONSIDERATIONS

Not applicable.

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS

1. Alternative approaches to restraints: Registered Nurses' Association of Ontario. (2012). Promoting safety: Alternative approaches to the use of restraints. Toronto, ON: Author. RNAO. ca/bpg/guidelines/promoting-safety-alternative-approaches-use-restraints
2. Evidence Booster: Becoming restraint-free - The impact on falls rate. https://rnao.ca/bpg/resources/evidence-booster-becoming-restraint-free-impact-falls-rate

MONITORING AND EVALUATION

Not applicable, but the care home practice should be monitored on a regular basis to ensure that physical restraints are not used as a measure for falls prevention.

RESEARCH PRIORITIES

Considering the findings of Brugnolli et al. (2020) [46], additional studies implementing and evaluating educational programmes alone or with consultation/guidance might offer additional evidence of the effectiveness of these programmes on reducing physical restraints use in care homes.

Working Group 5: Falls in Hospitals and Care homes

RECOMMENDATION 3 (Care homes Management and Interventions)

We recommend nutritional optimisation including food rich in calcium and proteins, as well as vitamin D supplementation as part of a multidomain intervention for falls prevention in care home residents. **GRADE 1B.**

RECOMMENDATION DETAILS

1. Most residents in care homes are deficient in vitamin D; therefore, we recommend vitamin D supplementation as part of a multidomain intervention for falls prevention in care home residents.
2. However, it is difficult to recommend a preferred dose regime as different regimes are evaluated in the literature without high level of evidence for one certain dose regime. Therefore, we cannot recommend one dose over the other. Care homes should aim for a 50 to 75 nmol/l Vitamin D level.

PRACTICAL TIPS

For practical tips, please see "implementation considerations and toolkits" below.

We do not recommend measurement of Vitamin D levels in care homes as this would not be cost-effective. Instead we recommend nutritional optimisation (e.g. foods rich in calcium and proteins), including vitamin D supplementation in all residents admitted to a care home.

OBJECTIVE

The objective was to review the literature to assess if nutritional optimisation including vitamin D supplementation should be given as part of a multidomain intervention for falls prevention in care home residents.

SUMMARY OF FINDINGS

1. In literature, conclusions on lack of benefits of vitamin D supplementation arise.[50] However, these conclusions should not be extended to care home residents as they may have benefits of Vitamin D supplementation.[51]
2. The Cochrane review of Cameron et al. (2018) [6] concluded that there is moderate-quality evidence that vitamin D supplementation (4512 participants, 4 studies) reduces the rate of falls by 28% (RaR 0.72, 95% CI 0.55 to 0.95; I^2 = 62%) in care homes (population with low vitamin D levels). No reduction in the risk of falling was detected (RR 0.92, 95% CI 0.76 to 1.12; I^2 = 42%).
3. In a recent cluster randomised controlled trial, facilities were stratified by location and organisation, with thirty facilities randomised to provide residents with additional milk, yoghurt, and cheese that contained 562 (166) mg/day calcium and 12 (6) g/day protein achieving a total intake of 1142 (353) mg calcium/day and 69 (15) g/day protein (1.1 g/kg body weight). The thirty control facilities maintained their usual menus, with residents consuming 700 (247) mg/day calcium and 58 (14) g/day protein (0.9 g/kg body weight). This intervention was associated with risk reductions of 33% for all fractures (121 *v* 203; hazard ratio 0.67, 95% confidence interval 0.48 to 0.93; P=0.02), 46% for hip fractures (42 *v* 93; 0.54, 0.35 to 0.83; P=0.005), and 11% for falls (1879 *v* 2423; 0.89, 0.78 to 0.98; P=0.04). The risk reduction for hip fractures and falls achieved significance at five months (P=0.02) and three months (P=0.004), respectively. Mortality was unchanged (900 *v* 1074; hazard ratio 1.01, 0.43 to 3.08) [51].

JUSTIFICATION

Although there is moderate evidence that nutritional optimisation including vitamin D supplementation can reduce falls in care home residents, there is a lack of firm evidence for its role as part of a holistic multidomain falls prevention intervention.

SUBGROUP AND SETTINGS CONSIDERATIONS

Not applicable.

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS

Implementing nutritional optimisation including vitamin D supplementation as part of a multidomain intervention for falls in care home residents is complex in the care home setting, despite the relatively low cost. Walker et al. (2020) [52] aimed to increase vitamin D supplement use uptake in Australian residential aged care facilities by evaluating a range of strategies to support implementation. They concluded that some strategies appeared to be associated with better outcomes, but the overall impact was limited and recommended that the role of organisational and governmental support for implementation should be investigated further.

MONITORING AND EVALUATION

Nutritional optimisation including vitamin D supplementation interventions should be monitored on a regular basis to ensure they are implemented as intended and effective.

RESEARCH PRIORITIES

Increasing the implementation and uptake of nutritional optimisation including vitamin D supplements should be a research priority.[52] More studies are needed to investigate the effect of vitamin D supplementation on falls in older care home residents including the preferred dose regime.

Working Group 5: Falls in Hospitals and Care homes

RECOMMENDATION 4 (Care Homes Management and Interventions).

We recommend including the promotion of exercise training (when feasible and safe) as part of a multidomain falls prevention intervention in care homes. **GRADE 1C.**

RECOMMENDATION DETAILS

1. We recommend promotion of physical activity (i.e. any bodily movement produced by skeletal muscles that requires energy expenditure. Physical activity refers to all movement including during leisure time, for transport to get to and from places, or as part of a person's work [53]) to reduce sedentary behaviours (e.g. daily sitting, TV-viewing time etc.) for all care home residents when feasible and safe.
2. Regarding specific recommendations for exercise in care homes: please see the recommendations of working group 4.
3. Given the high level of disability in this group, where possible, an exercise specialist (physical therapist, exercise physiologist) should be consulted to provide specialist, tailored advice on exercise and physical activity.

PRACTICAL TIPS

For practical tips, please see "implementation considerations and toolkits" below.

OBJECTIVE

The objective was to review the literature to assess if physical activity should be promoted as part of a multidomain intervention for falls in care home residents.

SUMMARY OF FINDINGS

1. The WHO defines sedentary behaviour in older adults as "time spent sitting or lying with low energy expenditure, while awake, in the context of occupational, educational, home and community settings and transportation" [53].
2. There is new emerging evidence indicating that high levels of sedentary behaviour are associated with cardiovascular disease and type-2 diabetes and cardiovascular, cancer, and all-cause mortality [53-55].
3. Greater sedentary time was related to an increased risk of all-cause mortality in older adults. Some studies with moderate quality of evidence indicated a relationship between sedentary behaviour and metabolic syndrome, waist circumference, and overweightness/obesity. The findings for other outcomes such as mental health, renal cancer, and falls remain insufficient to draw conclusions [56].

JUSTIFICATION

Although there is little evidence for this recommendation, the working group considered this an important recommendation based on expert consensus.

SUBGROUP AND SETTINGS CONSIDERATIONS

Regarding specific considerations for exercise in care homes: please see the recommendations of working group 4.

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS

1. "Evidence Booster: Best Practice Guideline Implementation and Estimated Cost Savings", RNAO, https://rnao.ca/bpg/resources/evidence-booster-best-practice-guideline-implementation-and-estimated-cost-savings
2. "Guidelines on Physical Activity and Sedentary Behaviour" WHO, Chapter "Adoption, dissemination, implementation, and evaluation, https://www.who.int/publications/i/item/9789240015128, p 70-75.

MONITORING AND EVALUATION

Falls and injury rate, amount, and type of physical activity participation as well as health conditions, disease severity and dementia sub-types if applicable, should be monitored through national surveys and audits.

RESEARCH PRIORITIES

Studies evaluating the effectiveness and feasibility of physical activity (on fall-related outcomes) in care homes are needed to develop informed guidelines and recommendations for addressing sedentary behaviour.

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Working Group 6. Cognition and Falls

RECOMMENDATION 1 (Assessment)
We recommend that routine assessment of cognition should be included as part of multifactorial falls risk assessment in older adults. **GRADE 1B**.

RECOMMENDATION DETAILS
1. Cognitive impairment increases risk of falls by 30%, but it also increases the risk of falls-related injuries by 100% including hip fractures, fractures of the arm, and head injuries [1].
2. Low cognitive performance in older adults, particularly of executive function, even in the absence of a known cognitive impairment or formal diagnosis of dementia, is associated with an increased risk of falls, justifying cognitive testing as part of multifactorial falls risk assessment in all older adults[2].

PRACTICAL TIPS
1. Clinicians involved in the care of older adults at risk for falls should be familiar with cognitive assessment tests that are used in their setting or country to properly interpret cognitive status, and to determine the contribution of cognitive impairment to falls risk.
2. Because executive dysfunction is strongly associated with falls, global cognitive screening tests that include executive function components should be used. The most commonly used screening assessment tools for cognitive status including executive function are the Mini-Mental State Exam (MMSE) and the Montreal Cognitive Assessment (MoCA). MoCA and 3MS (modified MMSE) are more sensitive screening tools to detect executive dysfunction when compared with MMSE. A limitation of any paper-based test is that individuals need normal or corrected visual function to warrant reliability of test scores, specifically during sentence reading, shape copying and animal naming.
3. Alternatively, if available, specific executive function tests, such as the Trail Making Test (TMT) part B, can be used since low performance on these tests have been shown to predict future falls [3]. Visual limitations need to be assessed prior to test administration to warrant reliability of scores as mentioned above.
4. If an older adult is hospitalised or placed in a care home, cognition should be assessed at admission and prior to transitions to other levels of care (such as to post-acute rehabilitation) to prevent future falls.

OBJECTIVE
Over one third of community-dwelling older adults experience at least one fall each year and the occurrence of falls rises steadily with age [3]. However, this rate is doubled in older adults with cognitive impairment [1]. Older adults with cognitive impairments are admitted to institutional care facilities five times more often than older adults without cognitive impairment because of a fall [2]. The length of hospital stay due to a fall is at least nine days longer than the average length of stay for all other causes of hospitalization in Canada [4, 5]. Older adults with cognitive impairments are also at high risk of major falls-related injuries (e.g. fracture and head injuries) and mortality [5]. The objective was to review the literature to assess the extent to which cognitive impairment contributes to falls and falls injury risk, and if cognitive assessment should be recommended as part of standard falls risk assessment protocols.

SUMMARY OF FINDINGS
1. A systematic review and meta-analysis of 27 prospective cohort studies with at least a 1-year follow-up period demonstrated that cognitive impairment was associated with an increased falls risk in both community-dwelling older adults (OR=1.33, 95% CI 1.18 to 1.49) and older adults living in long-term care facilities (OR=1.88, 95% CI 1.54 to 2.30) [1]. Cognitive impairment was also associated with an increased risk of fall-related injury (OR=2.33, 95% CI 1.61 to 3.36) and a fall resulting in a fracture (RR=1.78, 95% CI 1.34 to 2.37) among community-dwelling older adults. When stratifying by cognitive domain in community-dwelling older adults, the risk of fall-related injuries was increased for tests demonstrating global cognitive impairment (OR=2.13, 95 %CI 1.56 to 2.90) and executive dysfunction (OR=1.44 95% CI 1.20 to 1.73). The occurrence of fall-related injuries was greater in cognitively impaired fallers (65%) compared to cognitively healthy

fallers (40 %) [1]. Studies based in acute care settings with short length of stay or those that were restricted to a single disease-defined population (e.g. stroke or Parkinson's disease) were excluded.

2. Recommendations for addressing cognitive impairment during falls risk assessment and management were present in 11 out of 15 clinical practice guidelines identified in a recent systematic review of falls prevention and management guidelines in older adults [6].
3. A scoping review of 22 international clinical practice guidelines for falls prevention found that 10 out of 12 clinical practice guidelines for community settings and all the clinical practice guidelines for acute care settings included evaluation of cognition in falls risk screening and assessment protocol recommendations [7]. Another recent systematic review evaluated the relationship of falls risk to impairments in different cognitive domains and concluded that attention, executive function, and global cognition and the identification of mild cognitive impairment and dementia subtypes are important factors to inform a judgement of the individual's level of risk of falling [8].
4. A review of observational and interventional studies that assessed the role of cognitive status on falls indicated that low performance in tests of attention and executive function domains were associated with increased falls risk [4]. This review highlights the need for evaluating attention and executive function during routine falls risk assessments.

JUSTIFICATION

There is moderate evidence that low cognitive performance, particularly of executive function, even in the absence of a known cognitive impairment or formal diagnosis of dementia, is associated with an increased risk of falls [9]. Specifically, dementia and mild cognitive impairment double the risk of falls and falls-related injuries including hip fractures, fractures of the arm and head injuries [5, 9]. Therefore, cognitive assessment must be an essential component of any multifactorial falls risk assessment.

SUBGROUP AND SETTINGS CONSIDERATIONS

Our recommendations apply to all the settings including hospitals and care homes and aligns with recommendations from the 'Falls in Hospitals and Care Homes' (working group 5) and 'Multifactorial Falls Risk Assessment and Interventions for Preventing Falls in Community-Dwelling Older Adults' (working group 10)

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS

Different cognitive tests can be used to screen older adults for low cognitive performance often associated with higher risk of falls. General mental status assessed by the MMSE and executive function measured using the Trial Making Test B and a computerised neuropsychological test battery (NTB) are associated with an increased falls risk [4]. In high functioning older adults, global cognitive tests that have more items representing executive function, like the MoCA test, will be more sensitive in detecting subtle impairments. The MoCA is available in multiple languages and has been recently recommended as a global cognition test for assessing an interaction between mobility, cognition, and falls. Cognitive test batteries including tests of multiple cognitive domains such as the TMT A and B (visuo-spatial and processing), Digit Symbol Substitution Test (visuo-spatial and processing), Stroop test (executive function), and Rey Auditory Verbal Learning Test (memory) could also be successful screening tools, if feasible and available in particular clinical settings [10]. In settings where formal neuropsychological testing is not available, tests such as the MoCA and TMT A and B should be considered [10]. It is important that the assessors are trained to administer cognitive tests in a standard manner, and that the test scores be corrected by age and education to prevent potential biases [8]. It is important to acknowledge important factors that may influence participants' performance in these cognitive tests including uncorrected sensory deficits, underlying depression, side-effects of drugs, alcohol, electrolyte disturbances. This is important for an accurate decision about the individual's cognitive status.

MONITORING AND EVALUATION

We could not find high level evidence for how frequently cognition should be assessed or monitored in older adults in clinic or community settings. Experts believe that cognition should be an integral part of any comprehensive falls risk assessments. For instance, if a comprehensive falls risk assessment is performed every

year, then cognition should also be tested at the same visit or frequency. Education level of individuals need to be considered when selecting cognitive tests and interpreting results.

RESEARCH PRIORITIES

The clinical validity and utility of cognitive assessments (general mental status as well as specific cognitive domains) in the context of falls prevention studies need to be established. Future fall prevention studies need to be more inclusive of cognitively impaired participants particularly early dementia stages since this is a population at higher risk of falling with relatively preserved mobility independence in the community. There is also a need for identifying unique risk factors for falls in cognitively impaired older adults with a view of developing targeted pragmatic interventions (e.g. inclusion of participant's choice of the intervention, taking into consideration the physical limits of a participant, involving caregivers in delivering the intervention, training health care workers on how to deliver the intervention) in this at-risk population

Working Group 6. Cognition and Falls

RECOMMENDATION 2 (Interventions)
We recommend including both, older adults and caregiver's perspective, when creating the individual falls prevention care plans for adults with cognitive impairment since this strategy has shown better adherence to interventions and outcomes. GRADE 1C. (also see Older Adults Perspectives on Falls - working group 11)

RECOMMENDATION DETAILS
We recommend involving caregivers when educating older adults with cognitive impairment in 1) identifying and modifying environmental falls risk factors; 2) modifying lifestyle in terms of diet/nutrition and exercise routines to reduce falls risks; and 3) detailed recording of falls incidents. Clinicians can promote better adherence to a care plan designed to reduce falls in older adults with cognitive impairment. Specifically, one study shows that when individual preferences were incorporated in the intervention selection, falls outcomes improved [11, 12] and two studies show that when older adults and caregivers perspectives were also included, adherence improved [11, 13].

PRACTICAL TIPS
1. Caregivers of older adults with cognitive impairment should be an integral part of planning strategies to reduce falls risk (including both the assessment of falls risk and interventions to reduce falls risk).
2. Include caregivers to raise their awareness about falls risk and prevention then educate them to prevent falls in older adults with cognitive impairment, for instance, in how to identify and to modify environmental falls risk factors during assessments.
3. Both caregivers and old adults should be assessed for falls risk and educated for effective prevention. Include caregivers to advise individuals with cognitive impairment on how to modify lifestyle in terms of exercises to reduce falls risks during assessments.
4. Include caregivers to inform older adults with cognitive impairment on how to record falls incidents (e.g. when, where, how, injury sustained or not, health seeking behaviour) during assessments.

OBJECTIVE
To review the literature to evaluate whether caregivers should be involved in ascertaining fall history and falls risk reduction.

SUMMARY OF FINDINGS
1. Our rapid review with 6 randomised controlled trials (RCT) [11-16] with older adults exhibiting cognitive impairment reveals that involving caregivers in creating, implementing, and evaluating the care plan for falls risk reduction have better adherence [17]. However, caregiver involvement was identified as incidental findings in these studies and has limited level of evidence.
2. An included study in the rapid review [14], pointed out that caregiver involvement is important for people living in long-term care homes as the staff turnover is higher in residential care facilities) and care plans are often not implemented properly if only staff are involved.
3. All of the 6 studies in the rapid review [17] stressed involving caregivers when implementing life style modification interventions such as dietary modification, vitamin D prescription, regular exercise and avoiding movement during sundowning (a clinical state of confusion characterised by early evening disruptive behaviours such as agitation, restlessness, irritability, disorientation, and being demanding and suspicious [18]) for people with mild to moderate cognitive impairment living in the community.
4. All studies included in the scoping review [17] recommended involving caregivers in documenting a history of falls, especially in people with cognitive impairment who tend to underreport falls due to impaired memory.

JUSTIFICATION
Although there is low level of evidence for this recommendation, the working group considered this an important recommendation based on the scoping review conducted by the working group in 2022 [17].

SUBGROUP AND SETTINGS CONSIDERATIONS

Our recommendation applies to all care settings

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS

1. Caregivers should be involved when evaluating a history of falls in older adults with cognitive impairment, as well as in the risk assessment, older adult education and care planning and implementation
2. Clinicians should assess the readiness of the individual and their caregiver to adopt new and safer behaviours to prevent falls.

MONITORING AND EVALUATION

Overall, all 28 studies included in our rapid review [17], suggested the importance of monitoring and evaluation of care plans involving falls risk reduction as adherence to these plans can vary.

RESEARCH PRIORITIES

Further research should focus on falls reduction in people with cognitive impairment given that we found that only 29 of 2,559 original research papers on fall reduction included people with cognitive impairment. Only 4 of these 29 papers included people with diagnosed dementia. Clearly, given their increased fall risk [4, 9] compared to those with no cognitive impairment, older adults with cognitive impairment merit much greater focus on fall risk assessment and intervention research.

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Working Group 7: Falls and Parkinson's disease and Related Disorders

RECOMMENDATION 1 (Assessment)

We conditionally recommend a fall risk assessment for older adults with Parkinson's disease including a self-report-3-risk factor assessment tool, which includes a history of falls in the previous year, freezing of gait (FOG) in the past month, and slow gait speed, **GRADE 2B**.

RECOMMENDATION DETAILS AND SUMMARY OF FINDINGS

1. 'Freezing' is an important falls risk factor in older adults with Parkinson's disease (PD) and can be targeted with specific interventions.
2. Falls are a major and complex clinical problem in PD with a high impact on quality of life [1], risk of injury, and hospitalization [2]. One study of falls incidence in PD from the Netherlands confirmed that fall frequency is double that of age-matched older people [3] during spontaneous mobility in the community using a digital device combined with telephone checks. A recent estimate of the proportion of recurrent fallers in a population with PD was 55%. Moreover, fear of falling increased significantly over two years in the same cohort [4, 5]. Therefore, it is not surprising that PD has been denoted as the "falling disease" [3].
3. One of the reasons why people with PD fall so frequently is the loss of motor automaticity that accompanies the disease and this may be why having a history of falls is a determinant for a new fall in the next 6 month [6]. In addition, PD modifies the neural circuitry that controls gait and balance, leading to significant mobility problems such freezing of gait (FOG) [7], bradykinetic gait [8], difficulties with turning, and instability during stance, all of which enhance fall risk. Previously, a 3-step tool was developed to predict falling in the next 6 months with an AUC of 0.83 [0.77-0.88] [8]. This tool was based on 3 predictors: a history of a previous fall, the presence of FOG and slow gait speed. However, the predictive ability was not fully confirmed in verification cohorts [9, 10] and thus the 3 self-reported factors, but not the tool as such, are recommended as useful in the assessment of fall risk in PD at level 2B.
4. PD is also a progressive and heterogeneous disorder, which complicates the management of fall risk. Altered sensory, affective. and cognitive compensatory resources become entangled with the motor system changes [11-13]. Eventually, these brain networks become impaired by PD, increasing fall risk and curtailing the available strategies to manage falls. Hence, both the spread of pathology and the neural reserve left to cope with basal ganglia dysfunction are factors to be considered when designing fall programmes. Further, pharmacological treatment influences clinical decision-making about fall prevention. Axial problems proved to be only partially responsive to dopaminergic treatment and its response showed diversity across various postural and gait domains [14, 15]. As for FOG, dopaminergic medication was shown to reduce the number and duration of episodes, but FOG usually did not disappear completely [16, 17]. Other medications such as cholinesterase inhibitors have caught the interest of the research community as a strategy to improve gait and balance, but clinical uptake is not widely implemented, requiring further study [18].
5. Several modifiable fall risk factors in PD have been identified, some of which overlap with those of older people in general [1, 18]. In the domain of non-motor symptoms, three factors stand out: 1) orthostatic hypotension [7], 2) fear of falling [4, 19], and 3) cognitive decline [20]. Particularly, with respect to the latter, executive function impairment proved to be related to a higher fall risk [21-23], possibly driven by a compromised compensatory role of executive function to cope with the loss of automaticity. Consistent with this, poorer dual-tasking ability predicted increased fall risk in PD [24], albeit not consistently [25]. Independent risk factors in the motor domain similar to those of older adults include postural instability and lower limb muscle strength [26, 27]. Fall prevention strategies put forward for healthy older adults [28, 29] targeting these motor and non-motor risk factors can be expected to ameliorate falls in PD as well. However, effectiveness cannot be assumed and likely depends on the complexity of the disease profile of each older adult.

PRACTICAL TIPS

1. The presence of FOG is crucial for designing programmes for fall prevention. We define self-reported FOG in line with the new Freezing of Gait Questionnaire [30]: Freezing is the feeling that the older adult's feet are transiently glued to the floor while trying to initiate walking, making a turn or when walking through narrow

spaces or in crowded places. Sometimes it can be accompanied with trembling of the legs and small shuffling steps
2. Slow gait as a predictor of falling in PD is defined as self-selected gait speed < than 1.1 m/s [8].
3. Freezing-related falls are an important risk factor in PD that can be targeted with specific interventions.
4. Barriers to interventions should be addressed as part of a fall prevention strategy for PD through individual and clinician education regarding increased risk for falls and the importance of preventive interventions including exercise.

Working Group 7. Falls and Parkinson's disease and Related Disorders

RECOMMENDATION 1 (Management and Interventions)
We conditionally recommend that older adults with Parkinson's disease should be offered multidomain interventions, based on Parkinson's disease specific assessment and other identified falls risk factors. **GRADE 2B**.

RECOMMENDATION DETAILS AND SUMMARY OF EVIDENCE
MULTI-FACTORIAL INTERVENTONS
1. As noted above, among adults with Parkinson's disease (PD), multiple factors typically contribute to fall risk and falls. Multimodal interventions have the potential to target more than one of these underlying factors at the same time; from that perspective, they hold great promise. With that in mind, we conducted a search to identify studies that examined the effects of multi-modal interventions on fall risk among adults with PD.
2. For that purpose, we searched PubMed for articles published from inception up to date. Key words were chosen based on study design (controlled trials), exposure (multimodal interventions) and outcomes measures (falls and fall risk factors) and participants (PD subjects). Search terms were (Parkinson or Parkinson's) and (falls or fall risk) and (multimodality or multi-modality or exercise or training or therapy or dual-task or dual task or virtual reality or gaming or exergaming or feedback or motor cognitive or motor-cognitive). Other papers identified by the authors were also included.
3. Table 1 summarises the results of the search. Twelve studies were identified. A total of 1414 subjects were evaluated before and after multimodal interventions. The interventions included combined cognitive and motor tasks, combined aspects of balance (e.g. reaching, enhancing participants' anticipatory postural adjustment), and more specialised training such Tai Chi and an agility boot camp.
4. Studies that incorporated dual-task exercises, i.e. cognitively and physically challenging exercises for at least 8 weeks, showed better improvements in fall rates, near falls rate, and fall risk compared to the active control group, who received regular physical therapy treatment [31-34]. In the study by Penko et al. [32], subjects in the multimodal training group significantly decreased the number of falls from baseline to the end of treatment and the decrease in fall frequency was maintained during the 4-week follow-up; similar improvements were not seen in the control group participants who underwent active unimodal treatments such as stretching or lower limb strengthening. In addition, outdoor training [35], i.e. training on different surfaces and practicing fall-prone functional tasks (i.e. pulling or pushing doors, exiting or entering escalator or elevator, fast walking) had positive effects on gait and balance. This context-specific training may have enhanced the subject's stability and confidence in carrying out outdoor activities safely. Other interventions that combined training such as anticipatory postural adjustments [33], reaching, initiating rapid steps along with feedback on the accuracy of the performance produced immediate and 12-month carryover effects on enhancing balance confidence and stride length, two factors that have been associated with fall risk.
5. Virtual reality is a strategy that emerged in the past decade and now is increasingly popular in managing fall prevention. Virtual reality studies can target both gait and cognitive domains relevant to fall risk. Mirelman et al. [36] and Feng et al.[37] tested the potential effects of virtual reality on balance and fall incidence in PD, compared with a control group. Mirelman et al. [36, 38] showed that training with or without VR reduced the number of adults who reported 2 or more falls in six months (i.e. multiple fallers), with a slightly better

decrease in the treadmill alone group. Nevertheless, the rates of falls after training were 42% lower in the treadmill training plus VR than in the active treadmill training group. These findings illustrate how fall risk and fall incidence are not always parallel. Moreover, Feng et al. [37] showed that both groups improved from baseline to post-intervention however, 1) VR training resulted in significantly better performance compared with the conventional physical therapy group on the Berg Balance Test, and 2) only the VR group improved their MDS-UPDRS III score. Training both cognitive and motor function together to improve attention, a key cognitive factor that is associated with falls, as well as the motor component, may have beneficial effects.

6. Capato et al.[39] tested the effect of a multi-modal balance training programme supported by rhythmical auditory stimulation (RAS). This combination was based on previous studies suggesting that RAS has an immediate, positive effect on walking speed, stride length, and cadence. The idea was to train balance and gait aspects with RAS to test the added value of the auditory stimulation compared to a multi-modal balance training alone. The findings showed similar improvements in balance and gait parameters immediately after treatment in both groups. However, the combined intervention showed a better impact on falls self-efficacy. Six-month follow-up evaluations revealed retention only for the multi-modal plus RAS. The authors suggest that RAS-supported multimodal balance training may improve attention and task prioritization, thereby facilitating the selection of efficient balance compensatory strategies and enhancing the training effects, i.e. longer positive retentions. While promising, the effect of this intervention has not yet been evaluated directly on fall incidence.
7. Other multimodal interventions such as an agility boot camp with cognitive challenge [40] (ABC-C) programme and Tai Chi [41, 42] also had a positive impact on falls, balance, and gait in adults with PD. The ABC-C programme challenges both executive function/attention via simultaneous execution of demanding physical and cognitive tasks. Tai Chi aimed to improve balance and fall rates as it is presumed to improve axial domains, such as postural stability. Analyses at the 3-month post-intervention follow-up indicated that Tai Chi, compared to strength training or stretching, lead to fewer falls. The ABC-C improved anticipatory postural adjustment sub-score of the miniBEST. Secondly, the dual-task cost on gait speed (calculated as the percentage change of gait speed due to the second cognitive task) showed a significant positive treatment effect. Interestingly, older adults with severe cognitive and/or motor impairments improved more from this intervention. Finally, the posture impairment gait disorder (PIGD) sub-score of the MDS-UPDRS III significantly improved after this multimodal exercise compared to after education.
8. The PDSAFE is an interesting RCT [26, 43-45]. The goal here was to test a multi-centre, multi-dimensional, physiotherapist delivered, individually tailored, progressive, home-based programme as a fall prevention tool. To date, it may be the RCT for fall prevention with the largest cohort in adults with PD. Although fall risk measures (e.g. near falls, MiniBEST, falls confidence, and functional strength) improved as a result of the intervention, fall incidence did not. Secondary subgroup analyses revealed that adults with moderate PD decreased their fall incidence while adults with more severe PD increased their falls. In a sense, this finding is opposite to that reported in the ABC-C study. These results raise several important questions. Do we know which individuals with PD can benefit more from fall prevention protocols? What is the role of comorbidities (e.g. cognitive deficits, age-related factors, freezing of gait)? These questions have implications for tailoring personalised and beneficial therapies.
9. Despite the trends in favour of multimodal interventions for adults with PD for reducing the incidence of falls and/or fall risk, the extant literature has some limitations. First, while balance tests reflect fall risk, they may not fully capture the risk of fall. Indeed, among the twelve studies that we identified only seven directly evaluated the effect on fall incidence. Second, follow-up periods have been limited to six months. In the future, it would be interesting to evaluate the effects over a longer time period. In addition, as work in this area evolves, it may be informative to examine more fully secondary issues like compliance and long-term uptake and the specific PD populations who may benefit from specific types of multi-modal interventions. While one-size-fits-all has some benefits, its limitations should also be recognised.
10. This work to date suggests that multimodal interventions may lead to fewer falls and improve gait and balance among adults with PD, to a degree that is not seen in active control groups. These potential benefits may be explained due to the targeting of multiple fall risk factors. Training the most relevant factors simultaneously may hold the key to the optimal prevention of falls. Still, further work is needed regarding the added value of

multimodal training, the ideal intensity and frequency, how best to personalise interventions, and the ideal delivery form(s).

PRACTICAL TIP

While it's not clear which modalities are the ideal combination for individual older adults it is likely that multi-factorial intervention targeting specific risk factors may be optimal. This remains a topic for ongoing research.

Table 1: Summary of the effects of multimodal exercise on fall risk and fall rates in adults with PD

Study	Aim	Outcome measures	Type & time of intervention	Key findings & follow up effects	N of participants
Multimodal Balance Training Supported by Rhythmical Auditory Stimuli in Parkinson's Disease: A Randomised Clinical Trial. *Capato et al., 2020.*	Test if multimodal training (MMT)+RAS is better than without RAS Test if the effect is retained in the long-term.	Mini BESTest, Berg Balance Scale, retropulsion test, push-and-release test, FES-I.	*Gait training, visual cues, balance training. Control group did education programme. *10 sessions of 45 minutes (2 sessions/week over a 5-week period).	*Immediate effect - Both interventions improved (RAS improved more) compared to control group on MBEST as well with the secondary outcome measures. *Only RAS had immediate improvements on FES-I (compared to MMT & Control group). *1-month-FU: Improvements were retained. *6-month-FU: Improvements were retained only in the MMT+RAS group.	N=154
Virtual Reality Rehabilitation Versus Conventional Physical Therapy for Improving Balance and Gait in Parkinson's Disease Patients: A Randomised Controlled Trial. *Feng et al., 2019.*	To investigate the effect of virtual reality (VR) technology on balance and gait in older adults with Parkinson's disease.	Berg Balance Scale, Timed Up and Go Test, 3rd part of UPDRS and the Functional Gait Assessment.	*Games that challenges balance, attention, and executive function. *Control group did conventional physical therapy balance intervention. *45 minutes of treatment, once a	Both groups improved from baseline to post intervention however, 1. VR training resulted in significantly better performance compared with the conventional physical therapy group on BBS.	N=28

			day, 5 times a week, for a total of 12 weeks of VR training	2. Only VR group improved their UPDRS3 score.	
Multimodal Training Reduces Fall Frequency as Physical Activity Increases in Individuals with Parkinson's Disease. *Penko et al., 2019.*	To determine the effects of a multimodal training versus single modal training on motor symptoms, fall frequency, and physical activity in individuals with PD classified as fallers.	Physical activity, 30-day fall frequency, and UPDRS (3rd part).	*MMT group - cognitive and motor training simultaneously. *Control group separated cognitive and motor training. *Trainings were administered 3 times per week for 8 weeks.	*Only the multimodal training group significantly decreased their number of 30-day falls from baseline to end of treatment. *The impact on the MDS-UPDRS and on fall frequencies were maintained during the 4-week follow-up only for MMT group.	N=19
Addition of a non-immersive virtual reality component to treadmill training to reduce fall risk in older adults (V-TIME): a randomised controlled trial. *Mirelman et al., 2016.*	Evaluate the effects of treadmill training augmented with virtual reality on fall risk.	Fall rate. Participants kept a fall diary for 6 months. 2nd outcome measures: spatiotemporal gait characteristics (e.g. gait speed and variability)	*Treadmill + VR vs Treadmill alone. *3 times a week for 6 weeks, each session lasting approximately 45 minutes.	*TT+VR significantly reduced their fall rate after a 6-month follow up compared to the TT group, who did not significantly reduce their fall rate. Moreover, these results were consistent while analysing the PD subgroup. *Gait variability improved in TT+VR.	N=302
Balance and Gait Training with Augmented Feedback Improves Balance Confidence in Adults with Parkinson's Disease: A Randomised Controlled Trial. *Xia et al., 2014*	To examine the short- and long-term effects of augmented feedback balance and gait training on enhancing individuals with PD self-perceived balance	Activities-Specific Balance Confidence (ABC) Scale, limits-of-stability test, single-leg-stance test, and spatiotemporal gait characteristics.	*Balance and gait training with visual feedbacks on the accuracy of the performance. *Control group did hip & knee resistance training. *12 weeks.	*Experimental group showed better performances at balance tests at 3 and 12 months follow up. *Only the experimental group had stride length retention at 3 and 12 months of follow up.	N=51

	confidence levels.				
Tai Chi and Postural Stability in Patients with Parkinson's Disease. *Li et al., 2012.*	Whether a tailored tai chi programme could improve postural control.	Limits-of-stability test, gait characteristics, number of falls.	*Tai chi trainings VS strength trainings VS stretching. *60 min, twice a week, 24 weeks.	*Tai chi had better balance performances than the control groups. *Tai chi had better improvements regarding functional reach and stride length compared to control groups. *Tai Chi fall rate was lower during the 6-moths of intervention.	N=195
Multi-dimensional balance training programme improves balance and gait performance in adults with Parkinson's disease: A pragmatic randomised controlled trial with 12-month follow-up. *Irene et al., 2015*	To investigate the short- and long-term effects of a multi-dimensional indoor and outdoor exercise programme on balance, balance confidence and gait performance in adults with PD.	Balance evaluation systems test, activities-specific balance confidence (ABC) scale, gait speed, dual-tasked Timed Up&Go time.	*Combined indoor and outdoor trainings VS seated postural re-education, flexibility, strengthening, dexterity training. *2h session per week for 8 weeks.	*Better results of experimental group on BESTest (total and subsection scores), gait speed and dual-task TUG time. *6- and 12-month follow-up: retentions of all gains except for ABC test.	N=84
Effects of the agility boot camp with cognitive challenge (ABC-C) exercise programme for	To investigate whether the Agility Boot Camp with Cognitive Challenge	MiniBEST, Dual task 2-minutes-walk test.	*Cross over intervention of ABC-C trainings and education session.	*MiniBEST had similar changes in both groups however, APA domain had better scores for exercise	N=86

Parkinson's disease. *Jung et al., 2020.*	(ABC-C), that simultaneously targets both mobility and cognitive function, improves dynamic balance and dual-task gait in individuals with Parkinson's disease.		*80 minutes, 3 times a week, for 6 weeks.	group and only participants in a more severe motor or cognitive stage significantly improved their total MiniBEST scores after exercise, but not after education. *The dual task cost on gait speed showed a significant treatment effect. More severely cognitive and/or motor impaired older adults improved more from these interventions. *The PIGD sub-score of the MDS-UPDRS III significantly improved after exercise compared to after education.	
A randomised controlled trial of a home-based exercise programme to reduce the risk of falling among adults with Parkinson's disease. *Ashburn et al., 2007*	To evaluate the effectiveness of a personalised home programme of exercises and strategies for repeat fallers with Parkinson's disease.	Fall rates, Functional Reach, the Berg Balance Scale, PD Self-assessment Scale and the EuroQuol.	*Personalised multimodal trainings containing strength exercises, muscle stretching, range of movement for joints, balance training, strategies for fall preventions. *60 minutes, once a week, for 6 weeks.	*Significant positive effect of the exercise on reducing near falls at post intervention and at 6-month follow-up. *Trends were observed for fall reduction and for injuries from falls. *Significant improvement in functional reach test falls at post intervention and at 6-month follow-up.	N=142
Effects of Tai Chi on balance and fall prevention in Parkinson's	To examine the effects of Tai Chi on balance and functional	Berg Balance Scale, UPDRS III, Timed Up & Go and	*24-form Yang style Tai Chi exercise VS no intervention.	*Tai chi group had significantly lower fall rates.	N=76

disease: a randomised controlled trial. *Gao et al., 2014.*	mobility in adults with Parkinson's disease and determine whether fall incidence could be reduced by the Tai Chi exercise.	occurrences of falls.	*60 minutes, 3 times a week, for 12 weeks.	*Tai chi group had better Berg Balance Test scores. *No improvements were observed in UPDRS III and Timed Up & Go scores.	
A Randomised Controlled Trial to Reduce Falls in Adults with Parkinson's Disease. *Morris et al., 2015.*	To evaluate 2 physical therapy interventions in reducing falls in PD (compared to a 3rd control group).	Falls rates, UPDRS II&III, Timed Up & Go, gait speed.	*Movement strategy training (strategies to prevent falls, improve mobility and balance during functional tasks) VS progressive resistance strength training VS education. *120 minutes, once a week, for 8 weeks.	*The strength training group had 85% fewer falls than controls. *The movement strategy training group had 61.5% fewer falls than controls.	N=76
Multicentre, randomised controlled trial of PDSAFE, a physiotherapist-delivered fall prevention programme for adults with Parkinson's. Chivers et al., 2019	To estimate the effect of a physiotherapist delivered fall prevention programme for adults with PD.	Risk of repeat falling and rate of near falling.	*High intensity, strength and balance exercise programme, strategy training specific to the falls mechanism of the participant and delivered in a functional, home environment VS DVD about Parkinson's and single advice session, *12 hours of physiotherapist visit over 6 months (aiming to progress a personalised programme.	*Analysis of a 6-month follow up revealed that PDSAFE did not reduce falling. *Sub-groups responded differently to the intervention. *There was significantly lower risk of near falling in the PDSAFE compared with the control group.	N=474

RECOMMENDATION 2 (Parkinson's Management and Interventions)
We recommend that older adults with Parkinson's Disease at an early to mid-stage and with mild or no cognitive impairment should be offered individualised exercise programmes including balance and resistance training exercise. **GRADE 1A**. (WG4- Interventions Recommendation 4)

RECOMMENDATION 3 (Parkinson's Management and Interventions)
We conditionally recommend offering exercise training, targeting balance and strength to adults with complex phase Parkinson's Disease if supervised by a physiotherapist or other suitably qualified professional. **GRADE 1C**.

RECOMMENDATION DETAILS
Freezing of Gait as a Specific Risk Factor

1. The most specific risk factor for falling in PD is FOG, defined as a brief episodic absence or marked reduction of forward progression of the feet despite the intention to walk [46]. Pelicioni and colleagues[7] showed very directly that 61% of falls in PD were freezing-related, based on a prospective study characterizing more than 2043 falls by telephone interview. The suddenness of a FOG-episode combined with the difficulties that those with FOG (freezers) typically experience with controlling their centre of mass [47, 48] may partly explain this strong association with falling. Several other studies have also found FOG to be an independent predictor of falls in PD [26, 27]. In addition, having FOG was one of the three steps in a clinical tool to predict falls [8]. The algorithm also relied on detecting a previous fall in the past year and slowness of gait speed. External validation of this tool showed excellent test–retest reliability and acceptable accuracy in predicting falls, although FOG proved less important than in the original cohort [9]. Altogether, these studies underscore the idea that FOG constitutes a very important marker of fall-proneness, pointing to its relevance for treatment stratification.
2. Interestingly, the emergence of FOG as a milestone in the evolution of PD was predicted by several motor and non-motor determinants, which also bear resemblance to the risk factors for falls [49]. These determinants included lower limb symptoms [50], more severe axial symptoms [50], a higher daily dose of levodopa [51], poorer balance [9, 52], and cognitive disturbance [53]. However, specific FOG-related predictors were also found, i.e. gait festination [54], hallucinations [51], depression [52], anxiety [53], and motor breakdown of repetitive limb motion [50, 54]. Hence, the occurrence of FOG and by implication the emergence of higher fall risk reflects an increased disease burden. A compelling reason for classifying PD-fallers into freezers and non-freezers is that it offers a way to deal with the specific as well as the global impact of PD on falls risk. Also, the identification of freezing status allows us to differentiate between strategies on how to prevent falls and takes into account the need to address FOG-prevention specifically. However, the gold standard assessment of FOG requires specialised clinical testing and expert video rating [55]. Therefore, we recommend assessing the presence of FOG with the above-mentioned simple 3-step tool to screen for fall risk (see Practical Tip above) and use a more comprehensive test battery to determine FOG severity when designing treatment strategies to reduce FOG as a contributor to falls (outside the scope of this guideline).

Exercise Interventions for Falls in PD

1. Recently, a Cochrane review was undertaken (Cochrane protocol CD011574) to evaluate the effectiveness of interventions to prevent falls in PD. First, the review evaluated non-pharmacological interventions, mainly incorporating exercise aimed at reducing falls. Thirteen trials (1652 participants) including various forms of fall-preventing exercise were pooled and compared with active interventions that were not presumed to reduce falls. The results showed with high certainty that exercise reduced the rate of falls by 35% (Rate Ratio = 0.65 [0.53 to 0.80]). As for the number of fallers, exercise tended to decrease the rate of adults who reported one or more falls by 10% (Risk Ratio = 0.90 [0.82 to 1.00]), suggesting that exercise does not eliminate falls in adults who have fallen. No evidence was found for a differential effect of various modes of exercise, comparing mixtures of gait and balance, functional and strength training, and Tai Chi training. When

investigating the impact of exercise supervision, it appeared that fully supervised exercise was more effective in ameliorating falls (Rate Ratio = 0.56; [0.41; 0.77]) than partially supervised interventions (Rate Ratio = 0.85; [0.75; 0.97]). Furthermore, contrasting groups with high fall risk at baseline versus an unspecified risk did not affect the findings. However, data from two studies that reported on subgroup analyses based on disease severity did show a differential effect of exercise. Whereas a small reduction in the number of fallers was found in those with lower disease severity, a mild increase was apparent in fallers with higher disease severity (Rate Ratio = 1.19 [1.00-1.41]). Only minor adverse events were associated with exercise, though reported in merely four studies. Most notably, adverse events included non-injurious falls, pointing to the paradox that fall prevention exercise may increase the amount of physical activity undertaken thereby exposing participants to a higher fall risk [56]. Based on this high-quality evidence, we recommend that exercise be adopted as an effective fall prevention strategy in PD specifically in mild to moderately affected older adults.

2. The Cochrane review included exercise trials that targeted falls as a primary or secondary outcome, mostly aimed at balance training, walking programmes, and muscle strengthening exercise. Next, we will discuss the evidence on addressing two specific categories of intervention, addressing the motor-cognitive interplay and freezing of gait, which we consider being particularly relevant interventions for PD.

Exercise For Freezing of Gait

1. Based on the close association between FOG and falling, we will also summarise exercise studies specifically focused on improving self-reported FOG severity. A recent systematic review with meta-analysis, including 41 exercise studies and 1838 older adults, showed an overall favourable effect of moderate size (ES = −0.37) on FOG. The overall analysis included a wide variety of training modalities with FOG-severity as a primary or secondary outcome. Sub-analysis on which type of exercise was most effective revealed 3 interesting findings. First, exercises aimed at general health benefits had no effect on FOG. Second, specific training including teaching FOG-prevention strategies significantly reduced FOG-severity (ES=-0.35 [-0.56, -0.13]). Examples of such training were: cueing offered to overcome episodes; action observation of FOG-provoking situations; and FOG-prevention strategies in the home. Third, the largest effects sizes (ES=-0.40 [-0.64, -0.16]) were found for exercise targeting FOG-relevant compensatory systems to enhance the resilience for FOG. These interventions included cognitive training; dual-task training; balance training; curved treadmill training; regular treadmill training with cueing and obstacle avoidance training. Note, that most of these training modes also had relevance for tackling fall risk. The review also looked at 10 studies that selected freezers only as study participants, thus implicating only those with more advanced disease and cognitive decline. This sub-analysis showed that the positive effects of exercise on FOG remained (ES = -0.46, [-0.76; -0.17]). Although fall outcomes were not included directly, we recommend adopting exercise programmes aimed at ameliorating FOG as a useful strategy for reducing falls in PD.

Fall Prevention Exercise for Different PD Profiles

1. Fallers with different disease profiles may respond differently to exercise and physical training due to the impact of disease severity and compliance on the exercise intensity needed for optimal effects. We summarise five studies, two of which employed multivariable prediction analyses and three of which looked at subgroup responses to exercise. All of these studies were carried out as secondary analyses of supervised individually dosed exercise trials in the domain of gait and balance, targeting risk factors for falls.
2. The first prediction study looked at the effects of challenging balance training and found that better balance (primary outcome) was predicted by worse perceived health at baseline, worse cognition, and a worse Timed up & Go test [57]. The second prediction study on the effects of dual-task training also showed that worse dual-task gait speed (primary outcome) at baseline was associated with better gains on this outcome [58]. These results suggest that initial physical deconditioning (especially of the specific exercise target) predicts a better training effect, probably as there is more room to improve. However, the picture is more complex than that. In the second prediction study [58], global disease features, such as milder disease and better cognitive capacity, also predicted better dual-task gait speed, suggesting that the capacity to compensate is relevant too.

3. This somewhat disparate picture is largely confirmed by the three subgroup studies. First, a sub-analysis of freezers versus non-freezers was conducted as part of the V-Time study [59] investigating fall prevention training with two training arms: 1) a normal treadmill training and 2) complex treadmill training with cognitive exercise presented on a virtual reality screen. Both freezers and non-freezers reduced fall rates at 6 months in both training arms and this while baseline fall rates were significantly higher in freezers. Of note, fall frequency reduced more in the complex training arm in freezers but FOG did not. Second, the effects of a motor-cognitive training were assessed in a cross-over trial and compared to a control arm receiving merely education [60]. Freezers had greater gains on dual-task walking (secondary outcome) than non-freezers, again driven by lower dual-task capacity at baseline in freezers. When looking at the primary outcome (balance scores), older adults were classified into subgroups with more or less severe PD and more or less severe cognitive impairment. This analysis also underscored that the more severely affected groups had better balance scores after training [61]. Finally, a sub-analysis of the PD-safe trial [26] on fall prevention training delivered at home versus usual care and education told a different story. Overall, falling rates (primary outcome) only improved after PD-safe in those with *moderate* disease severity, and the programme led to better balance and reduced fear of falling. However, recurrent falling rates worsened after the PD-safe programme in the freezing group, which was not apparent in the non-freezing group. Thus, it seems that despite some positive training effects, the heightened fall risk in those with FOG still warrants a cautious approach towards safe mobility.
4. So far, no studies were conducted on adults with PD and severe motor and cognitive decline. As freezers proved to gain from challenging motor-cognitive training, we cautiously contend that late-stage older adults may still derive benefit from fall-prevention exercise as long as sufficient challenge to their limits of stability is provided [62]. As well, stringent supervision is needed during such exercise to ensure both safety and high enough practice dose in this cohort. Promising paradigms involving perturbation training on treadmills with virtual reality and split-belts are currently under investigation in healthy older adults [63], as well as in adults with PD[50]. One advantage of perturbation training is that it offers transferable and retainable fall-resisting skills while wearing a harness during the training. A drawback is that specific equipment is needed which will be less available in underserved areas. Also, perturbation training may generate high costs for health care and require ongoing safety measures when high-risk older adults undertake activities outside the training environment.
5. In conclusion, even in the face of more severe motor and cognitive depletion, training effects on fall rates and fall-related outcomes are possible in adults with FOG. The other side of this double-edged sword is that freezers are also more at risk for increased falling when they improve their fear of falling and mobility. Therefore, we recommend screening persons with PD on both their capacity to recover as well as on their likelihood to present with freezing-related falls.

PRACTICAL TIPS

1. Generally better fidelity and adherence is seen in supervised programmes.
2. A higher level of supervision is necessary in older adults with intermediate cognitive impairment, as such individuals may not be able to follow a self-directed programme, and for safety.
3. Specific subgroups of older adults (i.e. with FOG) may benefit from specifically targeted interventions (i.e. progressive balance and lower limb strengthening exercises).

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Working Group 8: Falls and Technology

RECOMMENDATION 1 (Interventions)
We conditionally recommend using telehealth and/or smart home systems (when available) in combination with exercise training as part of falls prevention programmes in the community. **GRADE E**.

RECOMMENDATION DETAILS
1. Definitions:
    - Telehealth involves communicating with older adults at home via telephone or video calls (i.e. telehealth).
    - Smart home systems aim to decrease environmental hazards and forecast potentially impending falls using sensors and Artificial Intelligence (AI) technology. Passive in-house sensors and vision- based sensors can help with identifying and eliminating potential risk factors.
2. There is emerging evidence in research settings that using wearable technology, i.e. devices worn on the body, to detect and prevent falls, could be efficacious for detection and prevention [1-13].
3. A recent systematic review and meta-analysis [14] that included 31 studies and a total of 2,500 older adults from 17 countries found that tele-health (telephone-based education) combined with exercise training were able to reduce fall risk by 16% [Risk Ratio (RR)= 0.84 95%CI 0.73 to 0.97]. Notably, despite not being statistically significant, telehealth alone showed a point fall risk reduction of 20% [RR = 0.80 95%CI 0.60 to 1.08] in this meta-analysis.
4. A recent study showed [15] that for participants from the community who followed an exercise programme that included aerobic exercise or resistance training, those participants using a wearable device for physical activity monitoring had fewer falls compared with those not using the wearable device, suggesting better intervention adherence.
5. For optimal use of resources, it is advised to withhold this recommendation for LMIC until evidence on effectiveness and implementation of technology in LMIC settings become available.

OBJECTIVE
To access and evaluate the evidence for the use of (digital) technologies in falls prevention

JUSTIFICATION
Technologies have been widely used for different health care purposes, but its effectiveness to prevent falls remains elusive. We found a meta-analysis investigating the effectiveness of telehealth alone or in combination with exercise programmes, and the use of smart homes to prevent falls. Telehealth (telephone-based education) + Exercise decreased the number of fallers by 16% [(RR=0.84 95%CI 0.73 to 0.97)]; Telehealth (telephone-based education) alone reduced falls risk by 20% despite not reaching statistically significance [(RR= 0.80 95% CI 0.60 to 1.08)]. Smart home systems demonstrated efficacy to decrease the number of fallers by 42% compared with houses without smart systems (0.58 95%C I0.44 to 0.77). Telehealth +Exercise was also found more efficacious than other technological approaches aiming to improve balance function [Standard Mean Difference=0.30 95%, CI 0.04 to 0.73] and balance confidence scores [Standard Mean Difference=0.29, 95%CI 0.09 to 0.48]. Other forms of balance training, such as exergame or cognitive game strategies did not have efficacy to improve balance.

RECOMMENDATION 2 (Interventions)
Current evidence does not support the use of wearables for falls prevention. However, emerging evidence show that when wearables are used in exercise programmes to prevent falls, they may increase participation. **GRADE 2C.**

RECOMMENDATION DETAILS
1. There is emerging evidence in research settings that using wearable technology, i.e. devices worn on the body, to detect and prevent falls, could be efficacious [1-6, 8-13]. However, this evidence has not been fully translated yet to the clinical encounter.
2. Recent study shows [15] that for participants from the community that followed exercise programmes which included aerobic exercise or resistance training, those participants using wearable for physical activity monitoring had has fewer falls compared to those not using the wearable, therefore suggesting better intervention adherence.

OBJECTIVE
With a rise in technology-assisted health monitoring, fall prevention and detection are more feasible and accessible. The use of technology in the clinic for fall risk assessment, interventions, or fall detection is growing. The objective was to review the literature to assess the current evidence for the effectiveness of wearable technology in detecting and preventing falls in older adults.

SUMMARY OF FINDINGS
The use of wearable technology, specifically for falls detection and prevention, is still in the proof-of-concept stage. Detection algorithms to distinguish falls from other day-to-day activities have mostly been tested via simulations on younger participants [16]. Temporal variables from a dataset of real-world falls harvested from older adults can inform fall detection using a tri-axial accelerometer and gyroscopes [3, 4]. Detecting a fall or pre-fall well in advance is helpful to prevent impact and related damage, therefore making timely detection an important consideration in fall detection [5, 6]. Other wearable technology such as around-neck [7] for context-aware fall detection also look promising. However, real-world accuracy of current systems is still low, as is shown in the example of a study performed with a combination of accelerometer, magnetometer, and gyroscope with audio feedback and GPS capabilities, which resulted in many false alarms during normal device use [8]. Many cohort studies have shown that sensor-based fall-risk assessments of motion parameters and balance can provide objective measures complementing conventional clinical assessment [9-12]. For example, an accelerometer combined with Timed-Up and Go duration enhances the sensitivity of fall risk assessment [13, 17]. Retrospective analyses of daily-life time-series accelerometry signals can indicate gait parameters such as variability, differentiating fallers vs. non-fallers [18-21] and thereby enhance supervised assessments. Gait accelerometry can also predict future fallers [20, 22] Furthermore, increased physical activity such as step-count and time spent in moderate-vigorous activity has been shown to reduce fall risk [23, 24]. The use of sensors to evaluate or reduce fall risk in Randomised Controlled Trials (RCTs) is still nascent. Five RCT studies using wearables were identified in this review. The RCT interventions used pedometers [15, 25] game-based training sessions with wearable sensors [26-28]. These interventions improved balance and mobility metrics [15, 26-28] and activity goal attainment [25]. While these interventions show evidence of being efficacious, more RCT studies using technology or connecting technology to existing interventions are warranted.

JUSTIFICATION
The evidence for using wearables for falls detection and prevention is available in research settings, however it has not been translated yet to the clinical encounter. Gait and balance assessment via sensors have the potential to be biomarkers for fall risk. These RCTs and cohort studies indicate that technology such as accelerometry is

potentially useful to complement conventional clinical assessment, for balance-improvement interventions, and overall, for preventing falls.

RESEARCH PRIORITIES

More RCTs that use technology to improve fall risk assessment are warranted. A near-future goal could be forming a consensus on identifying objective biomarkers of fall-risk via gait and balance assessment. Additionally, larger, and more diverse open-source fall repositories are encouraged to better enable generalizable machine learning methods as there is likely a problem of over-fitting in the current studies.[29] There is growing literature on the use of sensors to quantify performance in physical function assessments such as timed-up and go tests and gait analysis. Evidence also suggest that whole-body vibration, using vibration platforms, may have a protective role on falls prevention and should be a research priority for next studies.[30] Careful consideration should be given to the complexity of the technology; simplicity will likely result in higher adherence. Often laboratory simulations do not map to situations experienced in real-life and hence testing fall-detection should extend to real-world scenarios to improve accuracies and reduce false alarms. It is important to develop algorithms robust for use in the clinic, care homes, and the community.
We currently cannot formulate a recommendation regarding wearable technology for assessment or prediction and/or prevention of falls due to a lack of evidence. However, given this is an important research priority, future RCTs in falls prevention including wearable technology are urgently needed.

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Working Group 9: Falls in Low- and Middle-Income Countries

RECOMMENDATION 1 (Implementation)
Local context needs to be considered when implementing fall prevention programmes in low- and middle-income countries. **GRADE 1B**

RECOMMENDATION DETAILS
1. We advise that in LIMC, community dwelling adults aged 60 years and over to be screened opportunistically for fall risk during any clinical encounter, at least once a year, by enquiring about the presence of falls in the past 12 months.
2. While we recognise that this is relevant for global practice, this is particularly important in LMIC, as it has yet to be incorporated in healthcare policy. Screening measures need to be brief and simple, taking into account variable levels of training and expertise as well as time constraints**.**
3. Falls prevention should be included in LMIC policies using culturally sensitive strategies and tailored to local levels of expertise and resource availability.

PRACTICAL TIPS
The frequency of screening may be increased to twice a year or more frequently for high-risk groups including women, those in lower-income groups and in older adults living alone.

OBJECTIVE
Resources may be limited and variable depending on the setting and local context. Falls in older adults is given a low priority in low- and middle-income (LMIC) due to competing priorities in terms of ongoing threats of tropical and communicable diseases and the emerging threats of non-communicable disorders. However, adequate evidence is available on the prevalence and risk factors of falls in LMIC to justify a recommendation for opportunistic screening during encounters with the client by relevant agencies providing health and social care (such as, primary health care physicians, community health workers, volunteers) for older adults in LMIC.

SUMMARY OF FINDINGS
1. Differences between countries and regions (e.g. sunlight exposure, diet, environment, exercise preferences, prevalence of specific risk factors) may influence the success of implementing falls prevention approaches in LMIC that have been shown to be effective in high income countries. There is a small but growing research base of falls prevention RCTs from LIMC, with exercise approaches being most researched. For other interventions shown to be effective elsewhere, consideration of local issues is required to ensure that research and programmes implemented in these countries are effective, and relevant to the local context, people, and health system [1].
2. Falls in older adults are just as common in LMIC, and there are numerous publications on the prevalence and risk factors for falls, which would justify a recommendation for opportunistic screening. Older age and a history of falls is associated with increased risk of subsequent falls [2, 3]. The cut-off age of 60 years is used to define older adults due to the increased burden of diseases and high prevalence of multimorbidity and associated lower life expectancy in older adults living in LMIC [4]. High risk groups highlighted within the published literature from LMIC include older age, disability, lower income, female gender and living alone, which are groups who can be targeted through increased frequency of screening.

JUSTIFICATION
Opportunistic screening conducted during encounters between older adults and relevant health and social care providers is widely recommended by existing guidelines. The older adult may not necessarily present to health services after a fall in LMIC and may prefer to visit the traditional healer [5]. Conversely, some may attend emergency services to address their injuries, but the occurrence of a fall may not be recorded. In those with falls with minor or no injuries which may be recurrent or unexplained, the older adult may not seek medical attention. Further, the older adult may trivialise the fall, forget the fall or choose to conceal the information due to fear of loss of independent. Detection of the above cases is, therefore, only possible through direct enquiry

performed during any encounter with health or social care services. The specific mention of case detection in LMIC should hopefully help support existing falls practitioners within LMIC gain traction towards highlighting this important issue in older populations in LMIC, which now outnumber that of higher income countries, where most published studies have been conducted. Policymakers should no longer deny the need for identification of older adults at risk of falls in LMIC considering a large body of published evidence from LMIC is now in existence [6].

SUBGROUP AND SETTINGS CONSIDERATIONS

Increased frequency of screening may be justified in women, adults living with disability, lower income groups and in older adults living alone [7-16].

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS

Awareness is of primary concern within LMIC settings. Opportunistic screening in healthcare settings therefore need to utilise simple mechanisms, hence singling out individuals aged 60 years and over to be asked the single question, "have you fallen in the past 12 months" is potentially the most viable strategy. All agencies involved in health and social care provision to older adults should receive mandatory falls prevention education and consider incorporating falls screening in their processes which should also including screening for other commonly under detected age-related issues such as hearing, vision and cognitive problems. The decision who should screen should consider resource availability and hence should not be limited to trained healthcare workers. However, the implementation of opportunistic screening needs to be linked to available services downstream to address those at high risk of falls. The algorithm for subsequent actions for when the older adult with a history of falls is identified will need to be tailored to locally available resources and appropriate older adult education.

MONITORING AND EVALUATION

The proportion of clients or older adults aged 60 years and over utilizing the services provided by the health or social care provider who have been asked whether they have had a fall in the previous year could be used as a monitoring and evaluation tool.

RESEARCH PRIORITIES

Intervention studies to determine the value of opportunistic screening and effective implementation strategies for opportunistic screening in various care settings should be considered.

Working Group 9: Falls in Low- and Middle-Income Countries

RECOMMENDATION 2 (Assessment)

We conditionally recommend prioritising assessments of risk factors for cognitive impairment, obesity including sarcopenic obesity, diabetes, lack of appropriate footwear and environmental hazards as falls risk factors in low- and middle-income countries. **GRADE 2C.**

RECOMMENDATION DETAILS

1. All items of the multifactorial falls risk assessment mentioned in other recommendations should remain relevant to LMIC. Particular attention is, however, needed to address risk factors that are specific and/or highly prevalent in the LMIC setting.
2. While the relationship between obesity and falls in higher income countries have been contentious, the evidence linking obesity and falls in LMIC is more consistent. It is likely that sarcopenic obesity is more common in LMIC. We recommend addressing nutritional risk factors for falls (including deficiencies), obesity (including adiposity, excess body fat and sarcopenic obesity) and diabetes as important risk factors for older adults residing in LMIC.

3. Similarly, cognitive impairment is associated with lower educational attainment. We recommend critical attention to cognitive risk factors for falls in older adults within LMIC, as with lower educational attainment within older adults in LIMCs the number of adults living with dementia in these settings are expected to increase exponentially alongside rapid population ageing.
4. Those in LMIC are less likely to have access to safe and appropriate footwear with bare footedness, mostly indoors but sometimes outdoors, commonplace in countries with tropical climates. We recommend addressing poor footwear including bare footedness in older adults at risk of falls residing in LMIC as the lack of appropriate footwear is far more common in resource poor settings.

PRACTICAL TIPS

1. As part of routine screening of older adults in LMIC, if you are a healthcare provider, we recommend including a simple checklist of the above fall risk factors (obesity, diabetes, cognition and footwear).
2. The above approach will help stratify older adults into risk categories and delineate who may need more medical attention—particularly in regions in which medical resources may be scarce.

OBJECTIVE

While numerous risk factors for falls found in available epidemiological studies from LMIC have been found to mirror that previously established in higher income nations where most of the available evidence on falls risk factors have been studied, emerging evidence has, however, found unique, culturally-specially risk factors for LMIC [6].

SUMMARY OF FINDINGS

1. Obesity and diabetes are now more prevalent in many middle-income nations compared to higher income nations. Emerging evidence suggest that obesity is associated with increased risk of falls in middle-income nations.
2. Dementia and impaired cognition are associated with low educational level, which is frequent among older adults living in LMIC. Although there are few studies linking low cognition and falls in LMIC, we recommend that special attention should still be given to the assessment of cognition as a potential risk factor for falls.
3. Footwear preference differ in LMIC, particularly in tropical climates where bare footedness is common. Safe, appropriate and affordable non-slip footwear should, therefore, be addressed as part of falls prevention measures.
4. While available published evidence linking body composition, diabetes, cognition and foot coverings with falls in LMIC remains limited, emerging evidence from LMIC have been consistent in suggesting that diabetes and obesity are associated with falls [17-22]. Several published studies have addressed cognitive impairment, but with lower educational attainment considered the strongest risk factor for cognitive impairment and dementia, cognition is likely to be an important and prominent risk factor for falls which should not be ignored [23-29]. There is, also, weak evidence on increased risk of falls with inappropriate footwear which includes absence of shoes [30, 31].

JUSTIFICATION

While numerous risk factors for falls found in available epidemiological studies from LMIC have been found to mirror that previously established in higher income nations where most of the available evidence on falls risk factors have been studied, emerging evidence has, however, found unique, culturally-specific risk factors for LMIC [6]. The obesity epidemic has now moved to many middle-income countries, which have outpaced and outperformed higher income nations in obesity rates. While the relationship between obesity and falls in higher income countries has been contentious, the evidence linking obesity and falls in LMIC is sparse but far more consistent. It is likely that sarcopenic obesity is more common in LMIC. Similarly, cognitive impairment is associated with lower educational attainment, and older residents in LMIC are likely to have lower educational

attainment [32]. Those in LMIC are also less likely to have access to safe and appropriate footwear with bare footedness, mostly indoors but sometimes outdoors, commonplace in countries with tropical climates [33].

SUBGROUP AND SETTINGS CONSIDERATIONS

Falls in dementia populations in LMIC will require further evaluation, but it is expected that a sizeable proportion of those presenting with falls could have previously undiagnosed dementia [34]. Body size and obesity prevalence is geographically specific with Western Pacific and Middle Eastern nations reporting far higher prevalence of obesity [35]. Population specific nutritional and lifestyle interventions could be considered, which could have important implications on fall prevention in these settings. While footwear and cognition are also important in the developed world, cognition issues are greater with near absence of dementia diagnosis and lower education attainment being universal issues. Footwear issues also differ, as while heels are probably the main issue in developed countries, in developing countries it is total absence of footwear, or inappropriate footwear such as flip-flops, broken or wrong sizes that are the issues. Further, walking barefoot and use of flip-flops are issues specific to countries with tropical climates, therefore, the development of strategies to educate as well as ensure availability of safe, affordable footwear would be specific to LMIC with warmer climates [36, 37].

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS

Within LMIC, resources would be limited to ensure availability of nutrient rich food with lower caloric value, safe and appropriate footwear, exercise and educational programmes and appropriately trained personnel to screen for and manage those with cognitive decline. Low-cost innovations are therefore required to ensure that these neglected areas in falls prevention are appropriately addressed.

MONITORING AND EVALUATION

The proportion of individuals with falls who also had nutritional status, obesity markers (BMI, waist circumference), diabetes, cognitive assessment and footwear evaluation is relatively high in LMIC and could be used as quality indicators. Numbers of individuals living with obesity and cognitive impairment screened for falls occurrence may also be useful for monitoring.

RESEARCH PRIORITIES

Research into falls in individuals living with obesity, diabetes, and cognitive impairment in LMIC should be prioritised. As these conditions are likely to become increasingly prominent alongside the rapid population ageing in LMIC. As footwear issues are unique within LMIC, with clear geographical variation, footwear research should also be prioritised.

A further research priority is assessment of how to best incorporate the identification of falls risk (as already described in these recommendations) within more general poor health detection programmes, as this might be a more feasible approach in LMIC.

RECOMMENDATION 3 (Assessment)
We recommend that clinicians and caregivers in low- and middle-income countries settings should preferably use validated tools that are freely available in their country of residence to assess mobility and fall risk. **(GRADE E)**

RECOMMENDATION DETAILS
1. We recommend clinicians in LMIC begin with simple questions pertaining to fall history, followed by gait and balance assessments in individuals who screen positive to having a fall in the past year.
2. There is limited evidence for gait speed in LMIC, and this also is sometimes not practical as clear walkways may not be available, and instructions may be challenging. Some evidence exists for the use of timed-up-and-go and grip strength, but there remains inadequate evidence to recommend any single tool for LMIC.

PRACTICAL TIPS
If you are a healthcare provider in a LMIC, ask older adults if s/he has any subjective problems with walking or balance—this will help determine the level of risk and subsequent medical attention needed to provide.

OBJECTIVE
Falls are commonly the result of interacting risks, and one leading risk factor is gait and balance impairment. Gait and balance assessment has been recommended in older adults with risk of falls [38]. The objective was to review the literature regarding the best physical assessment tool for gait and balance impairment among older adults, performed as part of a multifactorial falls risk assessment for falls in LMIC.

SUMMARY OF FINDINGS
Earlier studies showed there is no robust single physical assessment tool that can be used to perform a perfect risk assessment for gait and balance in relation to falls risk [39-41]. Moreover, muscle strength appeared as a stronger risk factor and predictor compared to balance in younger older adults in LMIC [42, 43]. In a recent review, gait speed was found to be a sensitive tool in the higher-income countries—and given its low cost and ease of administration—it may be a useful tool to implement in LMIC [42, 43].

JUSTIFICATION
Whilst there is lack of firm evidence for the best single physical performance assessment tool to be used for assessment of gait and balance impairment among older adults with risk of falls in LMIC, timed up and go test (TUG), gait speed or muscle strength test (hand grip or sit to stand tests) may be used with reference to the normative data or cut off points established for the population if available.

SUBGROUP AND SETTINGS CONSIDERATIONS
This recommendation is valid for all settings within LMIC: community, hospital, and long-term care.

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS
These physical assessment tools may be used as an initial screening tool for falls risk in older adults. Further assessment should be performed using other comprehensive tools to identify specific impairments for personalised interventions.

MONITORING AND EVALUATION
A routine assessment of gait and balance performance should be a part of a holistic multifactorial fall risk assessment in older adults deemed to be at high risk of falls, at least biannually as a minimum interval.

RESEARCH PRIORITIES

Further studies on the validity of physical performance assessment tools as falls risk assessment for gait and balance impairment in older adults is required in LMIC.

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Working Group 10: Multifactorial Falls Risk Assessment and Interventions for Preventing Falls in Community-Dwelling Older Adults

RECOMMENDATION 1 (Assessment)
We recommend multiprofessional, multifactorial falls risk assessment should be offered to community-dwelling older adults identified to be at high risk of falling, to guide tailored interventions. **GRADE 1B.**

RECOMMENDATION 2 (Interventions)
We recommend offering multidomain interventions, informed by a multiprofessional, multifactorial falls risk assessment to community-dwelling older adults identified to be at high risk of falling. **GRADE 1B.**

RECOMMENDATION DETAILS
1. The evidence for a multifactorial falls risk assessment follows from evidence that effective multidomain interventions should be based on modification where possible of the falls risks factors identified in the individual, and not on a generic intervention regardless of individual characteristics.
2. Multifactorial falls risk assessment and interventions with a view to reducing the risk of falling needs to take into account the older adult's history of falling – frequency, characteristics and context, the presence of falls risks factors, the physical, cognitive, psychological and social resources of the person, and their priorities, values and beliefs. Therefore, an assessment with a view to co-designing an intervention with the older adult requires a broad approach, a comprehensive geriatric assessment (CGA).

PRACTICAL TIP
1. Details on the recommended content of the multifactorial falls risk assessment and accompanying multidomain interventions are described in recommendation details 3 and 4.
2. Ensuring sufficient uptake and adherence to achieve clinical effectiveness in practice depends on optimal implementation.

OBJECTIVE
Given the multifactorial nature of falls, it is assumed that comprehensive geriatric assessment (CGA) leading to individually targeted interventions would be effective. Previous literature has shown that several good quality trials have resulted in a reduction in falls [1, 2]. Our objective was to update the literature to assess if multidomain interventions (i.e. interventions with two or more components, individually targeted) reduce the rate of falls and risk of falling in community-dwelling older adults.

SUMMARY OF FINDINGS
A systematic review and network analysis published in 2021 [3] showed that when multidomain interventions were pooled together (i.e. considered as one intervention even if they consisted of different intervention components), in community dwelling older adults ≥65 years old they reduced the falls rate ((risk ratio [RR] 0.87, 95% confidence interval [CI] 0.80-0.95), but not the number of fallers (RR 0.95, 95% CI 0.89-1.01), compared to usual care. However, the authors also identified individual components which were associated with the various multidomain interventions being effective (e.g. environmental assessment and modifications + assistive technology + quality improvement strategies + management of orthostatic hypotension + basic falls risk assessment) and so we assert that multidomain interventions are effective in reducing both the rate and risk of falling in community-dwelling older adults [3]. In the network analyses it was also identified that multidomain approaches reduced the risk of falling in subgroup of community-dwelling adults ≥75 years old. The subgroup analyses of multimorbid older adults (≥65 years) were not significant. Post-hoc analyses in two large, pragmatic, randomised trials of multidomain interventions for preventing falls [4, 5] did not substantively alter network meta-analysis results or our recommendation.

JUSTIFICATION
The recommended components are derived from the following literature: a 2021 comprehensive systematic review and network meta-analyses [3] on interventions for preventing falls in community dwelling older adults,

two Cochrane systematic reviews [1, 2] assessing multidomain interventions for prevention of falls in older adults living in the community and two WHO summary reports on falls prevention in community dwelling older adults [6, 7]. The 2021 systematic review and network meta-analysis consisted of 192 studies (randomised trials and quasi experimental trials) enrolling community-dwelling participants ≥65 years old. Studies enrolling specific older adult populations (e.g. those with a stroke or Parkinson's disease) were excluded. Because its literature search was completed on February 27, 2019, post-hoc analyses were conducted including two large, randomised trials of multidomain interventions for preventing falls published in 2020 [4, 5]. These post-hoc analyses did not substantively alter network meta-analysis results or our recommendations. Review authors rated their certainty in the evidence using the CINeMA tool, which assesses the confidence in network meta-analysis results as per six domains: within-study bias, reporting bias, indirectness, imprecision, heterogeneity, and incoherence [8].

SUBGROUP AND SETTINGS CONSIDERATIONS

This recommendation is targeted to community-dwelling older adults. Multidomain interventions in other settings (hospital and care homes) are addressed in separate recommendations (working group 5).

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS

Two recent pragmatic trials [4, 5] illustrated that within current health care systems (UK and US) it is difficult to successfully implement interventions proven to be effective in previous smaller research trial settings [1, 9]. For successful and durable implementation of falls prevention interventions, collaboration between relevant medical disciplines, health care funders and governmental bodies is essential. Effective policies require engagement with appropriate stakeholders, including decision- and policymakers, healthcare funders, health care professionals, and older adults' associations and advocates [6].

MONITORING AND EVALUATION

Monitoring and evaluation of uptake of the intervention is warranted as it is the key to effectiveness. The intervention might need further adaptation upon follow-up, individualised according to the risk profile and goals and wishes of the older adult.

RESEARCH PRIORITIES

Further research is needed to assess how to obtain optimal knowledge translation. Effectiveness studies to date have not shown the same benefits as the efficacy studies. The reasons for this have been speculated about. This requires a more rigorous evaluation and studies to improve the question of translating the results from the efficacy studies to real world settings.

Furthermore, research to evaluate the cost-effectiveness of multidomain strategies is warranted. It is likely that the enhanced services would cost more to the prevention service provider but less to the health and social care system if sufficient falls, fractures, and other injuries are prevented thereby reducing hospital admissions and ongoing need for social care. Also, different risk groups may benefit from different interventions. Finally, studies in different settings, including low- and middle-income countries are warranted.

RECOMMENDATION DETAIL 3 (Assessment)
A multifactorial falls risk assessment for those at high risk of falling, which enables advice for falls prevention and management interventions, includes the following domains: gait and balance, muscle strength, medications, cardiovascular disorders including orthostatic hypotension, dizziness, functional ability and walking aids, vision and hearing, musculoskeletal disorders, foot problems and footwear, neurocognitive disorders (including delirium, depression, dementia, behavioural issues such as impulsiveness and agitation), neurological disorders (e.g. Parkinson's disease, neuropathy), underlying diseases (acute and chronic), concerns (fear) about falling, environmental hazards, nutritional status (including protein intake and vitamin D), alcohol consumption, urinary incontinence and pain. **GRADE E.**

RECOMMENDATION DETAILS 4 (Interventions)
A multidomain interventions in older community-dwelling adults at a minimum should include: strength and balance exercise, medication review, management of orthostatic hypotension and cardiovascular diseases, management of underlying acute and chronic diseases, optimizing vision (cataract surgery for those who need it, refraction) and hearing, addressing foot problems and appropriate footwear, vitamin D supplementation, optimizing nutrition, continence management, interventions to address concerns about falling, older adult education and environmental modification (including assisted devices and use of technology). **GRADE E.**

RECOMMENDATION DETAILS
1. Multidomain interventions encompass two or more components, individually targeted to the older adult based on findings from a multifactorial (or comprehensive) falls risk assessment. It is not a standardised set of interventions applied to everyone.
2. Multidomain interventions (i.e. a combination of interventions tailored to the individual), when offered, accepted and adhered to are effective for reducing the rate of falls in moderate to high-risk community older adults (as depicted in recommendation 1).
3. For optimal falls prevention, this needs to be addressed timely and with a multidisciplinary approach.
4. For reduction of fracture/injury rate it is recommended to include fracture risk management, i.e. consider need for osteoporosis treatment and protective devices.
5. In community-dwelling individuals, vitamin D supplementation is only indicated if there is vitamin D deficiency/insufficiency.
6. The strength of the evidence differs per component. Details can be found in the sections addressing individual components.

PRACTICAL TIPS
For details on specific assessments and interventions we refer to recommendations and recommendation details on these specific topics in the reports of other working groups and ad hoc groups.

OBJECTIVE
The majority of fallers or potential fallers have multiple risk factors, and many falls have complex, multifactorial causation. It is thus assumed that a comprehensive geriatric assessment (CGA) leading to individually targeted interventions aimed at falls prevention would be effective. Our objective was to review the literature to assess what components of the multifactorial falls risk assessment and accompanying interventions are likely to reduce the rate of falls and risk of falling in community-dwelling older adults.

SUMMARY OF FINDINGS
A recent systematic review and network meta-analyses found that different combinations of the components exercise, assistive technology (e.g. hip protectors, walking aids), environmental assessment and modifications, quality improvement strategies, management of orthostatic hypotension, and basic falls risk management (i.e.

cardiovascular management, medication review, and fracture risk management) integrated into multidomain interventions that are offered to community-dwelling older adults reduced their rate of falls and risk of falling [3]. Furthermore, we summarised in a review of published guidelines which components are consistently recommended as part of the multidomain intervention [10] based on the existing evidence. All guidelines included exercise interventions and the majority included medication review, environment modification, footwear and vision correction and cardiovascular interventions. The summary reports of the WHO are in line with these conclusions but add education, cognitive-behavioural interventions, vitamin D supplementation in those with deficiencies, wearables and other technological devices [6, 7]. As falls are one of the main 'atypical disease presentations' in frail (older) adults, also underlying (acute) diseases such as pneumonia or urinary tract infections need to be considered for management [11].

JUSTIFICATION

We based our recommendation on (1) *Interventions for preventing falls and fall-related fractures in community-dwelling older adults: A systematic review and network meta-analysis*, which was published in 2021 [3]; (2) *Cochrane review on interventions for preventing falls in older persons living in the community* [1]; (3) Systematic Review of Guidelines ' *Evaluation of Clinical Practice Guidelines on Fall Prevention and Management in Older Adults: A Systematic Review*' [10]; WHO report '*Step Safely'* [6] and WHO report '*Integrated care for older persons, evidence profile: risk of falls*'[7].

SUBGROUP AND SETTINGS CONSIDERATIONS

This recommendation applies to community-dwelling older adults only.

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS

To improve uptake of the interventions engaging older adults and joint goalsetting is needed. This asks for individual empowerment (education), shared decision making and strategies such as motivational interviewing. Also, resources need to be adequate to support the interventions. To this end collaboration with relevant stakeholders is essential.

For implementation, estimates of the amount of training, equipment, and time it will take to perform a comprehensive multifactorial falls risk assessment and intervention locally is needed for specific settings. This would include assessment of the capacity of providing specific interventions and the availability of other necessary resources. In general, a single health care professional approach may be suboptimal in comparison to a team approach.

MONITORING AND EVALUATION

Monitoring and evaluation of uptake of the intervention is warranted as it is the key to effectiveness. The intervention might need further adaptation upon follow-up, individualised according to the risk profile and goals and wishes of the older adult.

RESEARCH PRIORITIES

Further research is needed to assess if specific components (besides exercise) can be prioritised. Also, given the complexity and multitude of the components, implementation research on optimal uptake is warranted, taking into account different health system structures. Also, different risk groups may benefit from different interventions. Finally, studies in different settings, including low- and middle-income countries are warranted.

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Working Group 11: Older Adults' Perspectives on Falls

RECOMMENDATION 1 (Stratification)
We recommend clinicians should routinely ask about falls in their interactions with older adults. **GRADE 1A.**

RECOMMENDATION DETAILS
Clinicians cannot rely solely on older adults reporting falls, as studies indicate that many do not, for a variety of reasons. [1-4]. This appears to be more common among males with a less than a third reporting falls spontaneously to clinicians [1]. Identifying more older adults who have fallen would potentially lead to more of those falling benefiting from an assessment of fall risk followed by appropriate interventions.

PRACTICAL TIP
Asking about falls should be done at least annually (e.g. during periodic health evaluations), on admission to facilities or services, at transitions of care, or during other clinical encounters. The following question can be used, ". . . have you had any fall including a slip or trip in which you lost your balance and landed on the floor or ground or lower level over the last year [or other time duration]?"[5]. For those with significant cognitive impairment (e.g. major neurocognitive disorder), a family member or other informant could be asked.

RECOMMENDATION 2 (Assessment)
As part of a multifactorial falls risk assessment, clinicians should enquire about the perceptions the older adult holds about falls, their causes, future risk, and how they can be prevented. **GRADE 1B.**

RECOMMENDATION DETAILS
The scoping review on the perspectives of older adults showed that they are heterogeneous in the beliefs they have about falls. Many older adults have low levels of knowledge about their causes and prevention of falls, with erroneous beliefs about the causes, their own risk of falling and how best to minimise the likelihood of future falls. Because of the diversity of opinions held by older adults, questioning the individual is required to determine this information for that person. Knowing what their beliefs are would allow clinicians the opportunity to answer questions, address misconceptions, and provide accurate information about falls and their prevention.

PRACTICAL TIPS
Though the evidence base is limited, men appear to view fall risk differently than females [6, 7]. They seem more confident in their abilities and less willing to adapt their routines in order to prevent falls. Baseline knowledge about how to prevent falls among older adults is often poor. For example, Hill et al in a study of older adults about to be discharged from hospital found low levels of knowledge about fall prevention strategies [8]. It can be helpful when discussing fall prevention strategies to include improving mobility and achieving functional independence as positive goals for the recommended interventions in addition to preventing falls.

RECOMMENDATION 3 (Intervention)
We recommend that a care plan developed to prevent falls and related injuries should incorporate the values and preferences of the older adult. **GRADE 1B.**

RECOMMENDATION DETAILS
Engaging older adults in a discussion about their preferences coupled with shared decision-making can improve adherence with recommendations and outcomes [9].The aspects included in a scoping review of 52 studies included: the meaning of falls, perceived causes, assessment of personal risk, reaction to this perceived risk and priority given to falls as a health concern. Fall prevention interventions can be time-consuming, intensive and of long duration. An older adult should be informed of both the benefits and burdens of falls prevention therapy, to enable them to make an informed choice about participation. An older adult's knowledge and attitudes about falls and the priority they give to their prevention will determine whether, or what type, of therapeutic interventions they would be willing to engage in.

PRACTICAL TIP

- The preferences of older adults for interventions to prevent falls are varied. They should not be assumed to be the same as the clinician and have to be assessed at an individual level.
- For those with cognitive and functional limitations, the development and then implementation of a care plan to prevent falls and related injuries will also require the involvement and training of informal (unpaid) and/or formal (paid) caregivers.

SCOPING REVIEW OBJECTIVE & JUSTIFICATION

With improvements in the social determinants of health and better access to medical services, larger numbers world-wide are reaching older ages [10]. Many, though, will experience age-related health concerns including falls and related injuries [11, 12].

Up to a third of community-dwelling older adults fall annually [11]. They are the leading cause of fatal and non-fatal injuries in this age group [11] and can also precipitate functional decline, loss of independence, and psychological distress [12]. Given the high prevalence of falls among older adults and their potential adverse impacts on both personal health and healthcare utilization, various interventions have been designed to prevent falls or minimise the risk of injury from them [12, 13]. Their uptake will be influenced by how serious older adults view falls and their belief that they are preventable [14]. Stevens et al found that less than a third of older adults (31.2% among women vs. 24.3% in men) who had fallen reported them to their healthcare provider [1] while Hill et al reported that over a third of those who had fallen were undecided about or dismissive of participating in a fall prevention programme [15]. We conducted a scoping review [16, 17] (specific methodology used available upon request) of the peer-reviewed literature on the perceptions older community-dwelling adults hold about falls in order to: (a) identify which aspects of the topic have been studied (including both where and how); (b) describe the range of perceptions older adults have about falls and their risk of falling; (c) determine, where possible, which socio-demographic factors and other personal characteristics influence these perceptions; and, (d) identify areas requiring further study.

This scoping review was used to develop practical advice for incorporating the perceptions of older adults about falls in efforts to prevent them and their associated adverse consequences in older adults. Studies that dealt with the willingness of older adults to engage in select fall prevention interventions were excluded as our focus was on their perceptions about falls. We were aware of an on-going systematic review examining how the values and perceptions of older adults influence their preferences for fall prevention interventions that should shed light on this critical issue [18].

SUMMARY OF EVIDENCE

A total of 52 studies were identified [2-4, 6, 19-66]. Nearly all (48/49, 97.6%) studies reporting primary data or secondary analyses of collected data on the topic originated in North America, Europe, Asia, and Oceania. Most studies were either qualitative (25/52, 48.1%) or quantitative (19/52, 36.5%) and collected data through interviews, questionnaires, or surveys. The number of studies included in the three literature reviews ranged from 11 to 19 (mean 13.67). Among studies reporting primary data or secondary analyses of collected data there were a total of 30,875 participants with significant variation in mean sample sizes by study type (i.e. greatest in quantitative studies and smallest in qualitative ones). Participants were typically females between the ages of 70 and 80, which may limit our ability to extrapolate our findings to other demographic groups such as men. Of the articles reporting on the fall history of participants, none dealt solely with non-fallers (i.e. in all at least some participants had fallen). Additional explicitly stated criteria used in some studies to select study participants included adequate cognition (n=13), language fluency (n=12), level of mobility (n=6), and medical status (n=6). Four studies distinguished between indoor and outdoor falls while seven noted whether the falls resulted in an injury. A minority of the primary data and secondary analyses of collected data studies (19/49, 38.8%) provided information on participants' race or ethnicity. In American studies that reported on race (n = 8), seven consisted predominantly of white participants, while one was made up entirely of Latinos [34].

The perceptions of older adults are diverse. This heterogeneity must be kept in mind. Five themes were developed for categorizing the data extracted: (a) meaning of falls to older adults, (b) perceived causes of falls,

(c) assessment of personal risk of falling, (d) reaction to falls or the risk of falling, and (e) priority given to falls as a health concern. Any associations to socio-demographics and other characteristics within these different themes were also noted.

Meaning of Falls to Older Adults

The findings of thirteen studies (9 qualitative, 2 literature reviews, 2 quantitative) fell within this theme [2, 4, 23, 31, 32, 34, 45, 48, 51, 53, 57, 62, 64]. Falls were described as a potential threat to their life [48], personal identity [31, 32], independence [4, 32, 34, 51], and quality of life [23, 44, 45] The response of older adults to these perceived threats ranged from denying their presence [51] to letting them dominate their lives [53]. The tension between these two extremes could be played out within an individual [64]. Older individuals who had fallen were viewed in a negative light (e.g. they were perceived as frailer) by other older adults leading to a desire to distinguish themselves from those who fall [4, 31, 57].

Perceived Causes of Falls

Twenty-one studies (17 qualitative, 3 mixed methods, 1 literature review) provided data on this theme [2, 3, 19, 20, 25, 28, 31, 32, 38, 39, 42, 46, 49, 52, 53, 55, 56, 60, 63-65]. A significant proportion of older adults viewed falls and related injuries as something either intrinsically tied to ageing or arising from chance – in other words, inevitable [2, 3, 19, 20, 28, 31, 39]. This led to a degree of fatalism about their occurrence. Potentially modifiable (through adaptation, avoidance, modification, training, or therapy) fall risk factors noted by older adults included age-related declines in health status [31, 38, 49, 53, 56, 60, 65] (especially when explaining the falls of other older adults) [28], poor balance/gait abnormalities [38, 49, 52, 53, 65] (again, when explaining the falls of other older adults) [63], having fallen before [28], physical weakness [53, 60, 63, 65], personal behaviour (e.g. not paying attention, hurrying) [25, 28, 31, 38, 56, 65], medications [38], footwear [53], other people (e.g. from bumping into them or having to try to avoid contact with them) [31], the weather [52, 65], and the physical environment [25, 28, 31, 49, 53, 56, 64, 65]. These factors were viewed as either the sole cause of a fall [56] or a contributor along with other ones [25]. Participants tended to emphasise extrinsic over intrinsic factors as being potentially modifiable, particularly when considering their own falls.[42, 52] Many older adults felt being more careful was an effective approach to preventing falls [32, 39, 46, 49, 55, 64].

Assessing Personal Risk of Falling

Seven studies (4 qualitative, 2 quantitative, 1 mixed methods) dealt with this theme [4, 6, 30, 33, 42, 56, 65]. While most older adults were accurate in assessing their fall risk [30, 56], a third or more either under- or overestimated it [30, 42, 65]. Underestimating was more common than overestimating [30, 42, 65] and occurred even among those who have fallen, especially if they had fallen only once with no associated injuries [4, 33]. Overestimating risk was associated with psychological factors (anxiety, depression, neurotic personality traits) and executive dysfunction [30]. Men were more confident they could reduce their fall risk than women who tended to blame themselves (e.g. being careless) or others for their falls [6].

Reaction to Falls or the Risk of Falling

Twenty-six studies (16 quantitative, 8 qualitative, 2 mixed methods) addressed this theme [2-4, 21-24, 26, 27, 29, 34, 35, 37, 41, 43, 44, 46, 50, 54, 55, 58, 59, 61, 62, 65, 66]. Concern about (fear of) falling (FOF) was the most reported reaction and affected a third or more of older adults [21-24, 26, 34, 35, 41, 43, 44, 46, 50, 54, 59, 61, 65, 66]. It was more common in women [21, 23, 35, 41, 44, 54, 59, 61, 66], at older ages [21, 35, 66], and among those who had fallen [21, 24, 34, 35, 43, 46, 50], especially if there had been multiple falls [44, 66] or an associated injury [23]. Characteristics of the built environment influenced the likelihood of FOF [22, 26]. Rates of FOF appeared higher in Asian countries than European or North American ones [43]. FOF adversely affected the health-related quality of life of older adults [22] and could lead to activity restriction [34]. Non-FOF reactions included restricting activities to prevent further falls [27, 29, 34, 37, 58, 66], loss of independence [55], and/or experiencing psychological distress (e.g. anxiety, loss of confidence) [27, 58, 62]. Older adults expressed reluctance to speak of their falls possibly because of the threat they presented to independence, a desire not to worry their family, or a belief that falls were not a serious issue [2-4].

Priority Given to Falls as a Health Concern

Three studies (2 quantitative, 1 qualitative) addressed this theme [39, 40, 47]. Falls among older adults were often not seen as a high priority issue requiring action. In one study, only 10% of those deemed at risk for falls prioritised their prevention [40]. In another study, greater concern was expressed about the potential burden of the interventions that might be recommended than the falls themselves [39]. Those who were older, more fearful of falling, experiencing gait/balance issues, or had repeated falls made it a higher priority [40].

RESEARCH PRIORITIES

1. Further research on the associations between perceptions about falls and socio-demographic characteristics. Work done to date indicates, for example, significant relationships between gender [21, 23, 35, 41, 44, 54, 59, 61, 66] and FOF.
2. More research is needed to understand the stability and evolution of these perceptions over time, their relationships with fall outcomes, and whether they can be modified (and by what means).
3. Research should extend to parts of the world where few studies been done to date (e.g. Africa, South America).
4. Greater involvement of older adults often excluded (e.g. those with significant cognitive impairment) or under-represented (e.g. people from disadvantaged backgrounds, certain racial and ethnic groups) in the research done to date should be encouraged).
5. Systematic review of how the values and preferences of older adults affect the choice and outcomes of fall prevention interventions (on-going) [18].
6. Further research on the roles and experiences of formal (paid) and informal (unpaid) caregivers of older adults in fall prevention. An integrative review of 15 studies highlighted the complexity and importance of this issue [67].

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RECOMMENDATION FEEDBACK FROM OLDER ADULT PANEL
AUGUST 18, 2022
Dr. David B. Hogan

INTRODUCTION: 30 to 60 minutes semi-structured virtual interviews with four older adults were conducted to receive feedback on the draft recommendations [1]. Those agreeing to participate were sent a meeting agenda, the most recent version of the draft recommendations, and specific questions that would be raised with them about terminology used throughout the document (in an effort to strive towards consistency and avoidance of terms with negative connotations) and specific recommendations made by WG 10 (Multifactorial Falls Risk Assessment/ Interventions) and WG 11 (Older Adults' Perspectives on Falls). Participants were invited to provide feedback on any recommendation, potential gaps, and provide any other comments they wished to make. The meetings began with a request to record the interview (all agreed) followed by a brief introduction to the World Fall Guidelines project.

GENERAL COMMENTS: Those interviewed were complimentary and spoke highly of the recommendations. They found them thorough ("I was amazed on how thorough they were"), clear, interesting, and, in their opinion, useful for clinicians.

Minor Points: One participant had trouble understanding all the recommendations ("At my age I'm less quick … [and have] diminished understanding"). "Orthostatic hypotension" had to be explained to another participant.

TERMINOLOGY: Discussions were specifically held about the different ways older adults, concerns about falling, care homes, and clinicians were referred to in the document to determine if there was a preferred option:

- Participants either had no preference to any of the terms used for them (i.e. older adults, older fallers, [older] patients) or favoured <u>older adults</u>. "Patients" received the most negative response ("… it denotes being infirm…"). Based on this, the use of the word "patient" is not recommended. "seniors" was suggested by one.
- All favoured the term <u>concerns about falling</u> over "fear of falling." The use of the word "fear" carried connotations of "giving up" while "concerns" offered a more hopeful perspective ("... the problem can be addressed … [and] I can convert to being a non-faller").
- The terms "nursing home" and "care home" were equally acceptable. One brought up the possibility of "long-term care facility" (as equivalent to nursing home) and another the felt "community" or "continuum" of housing and healthcare options for older adults better reflected the complexity of congregate living settings ("… there are different types …").
- The term <u>clinician</u> was acceptable to all as were the other options (i.e. multiprofessional [team], trained care workers, healthcare provider). One participant suggested "fall professional" as an alternative term.

One participant asked if there was a possible alternative to "community-dwelling" while another "really liked the term."

WG 10 RECOMMENDATIONS (Multifactorial Falls Risk Assessment and Recommendations): The general sentiment about the recommendation on assessment was that though extensive, this would be acceptable if all the components were needed ("… it is a lot but justifiable"). It was seen as a way to provide personalised care to the older adult. Participants were asked specifically about the feasibility and burden of the assessment and management recommendations. While generally supportive, some concerns were raised:

- How (including who would do it) and where would a multi-component assessment be done?

- One felt the full assessment as outlined might be impractical for a primary care physician. Possibly a physician "extender"/ physician assistant/ nurse practitioner could do the bulk of the evaluations and then review them with the responsible physician. Alternatively assessments might be done in a falls clinic by a multidisciplinary team.
- One voiced a desire to have all done at one time in one place and was concerned about making separate trips for unneeded blood work (e.g. 25-OH vitamin D level) or an ECG, feeling "… surely those doing the fall assessment could determine if they were required"). Multiple visits to complete the assessment raised issues of "practicality."
- Another advocated for consistency in the terms used in WG 12 recommendations and brought up the use of "foot problems" (recommendation #3) and "foot health" (recommendation #4) as an example.

WG 12 RECOMMENDATIONS (Older Adults' Perspectives on Falls): All agreed with the three WG 12 recommendations. Clarification on how older adults would be asked about falls was requested. Minor alterations brought up as options were adding "or concerns" after "perceptions" to #2 and "respect" to #3 ("… should respect and incorporate …").

OTHER RECOMMENDATIONS: One said they "loved" the WG4 recommendations.
A question came up about the first recommendation of WG5 (Hospital & Care Homes) dealing with the assessment in care homes. It was asked whether some type of screening should be done for those deemed at higher risk. It was pointed out you needed to read the first and second recommendations together. One participant asked if "solely for fall prevention" should be added to the recommendation about not using physical restraints.

GAPS/ OTHER COMMENTS:
Behaviour/ education – One noted the utility of being advised by their falls clinics [2] on which activities to avoid ("I know now not to go up on the roof"). Another concurred that education on activities to avoid was important ("… [become] more aware of what should be avoided"). A third one mentioned "self-talking" as a way to focus your attention on what you should be doing to minimise fall risk, particularly in a challenging environment [3]. These comments underscored the belief held by older adults of the importance of education [4].
Different audiences – Considering all potential audiences, including older adults, and tailoring the message to their particular needs should be part of our dissemination plan.
Settings – It was suggested we consider how our recommendations should be used by older adults in retirement communities, independent apartments, assisted living, and other forms of congregate housing that lie between a private residence (including multi-generational homes) and care homes. This will require thinking about both the characteristics of the resident of these settings and how fall prevention programmes might be offered in them.

Technology – There was interest in the use of technology for fall detection (as well as fall risk assessment and management) and in programme delivery (e.g. offered virtually vs. in-person).

Taking fall prevention programmes to older adults – As currently written, the implication is that the older adult would go to the fall prevention programme. There was interest in developing programmes that travel to where older adults live (especially congregate living settings).

ENDNOTES
1. Members of the World Fall Guidelines steering committee were asked to provide the names and contact information of older adults fluent in English with lived fall experience who might be willing to take part in interviews and/or focus groups about the World Fall Guidelines. Thirteen were identified and contacted. Four agreed to participate. Their characteristics were as follows: 1 female/ 3 males, age range

72-89 years with average of 78.75 years, none with a diagnosed neurocognitive disorder, 2 had fallen/2 were concerned about falling, and 3 were from Canada/ 1 the United States.

2. At this clinic, there are no formal education sessions but during the exercise programme offered by the clinic, time is spent discussing fall risks when participants share their experiences about falling. This is used as an opportunity to provide education about which factors may have contributed to their fall and ways to prevent future falls.
3. This person was referring to a programme developed by Baycrest Hospital in Canada called "Learning the Ropes for Living with MCI®" where there is an "Organise, Stop, See it, Say it" component (note: this programme has not been studied specifically for fall prevention). Accessed August 9 at - https://www.baycrest.org/Baycrest/Healthcare-Programmes-Services/Clinical-Services/Neuropsychology-Cognitive-Health/Neuropsychology-Treatment-Programmes/Learning-the-Ropes-for-MCI
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Working Group 12: Concerns about Falling and Falls

RECOMMENDATION 1 (Assessment)
We recommend including an evaluation of concerns about falling in a multifactorial falls risk assessment of older adults. **GRADE 1B.**

RECOMMENDATION 2 (Assessment)
We recommend using a standardised instrument to evaluate concerns about falling such as the Falls Efficacy Scale International (FES-I) or Short FES-I in community-dwelling older adults. **GRADE 1A.**

RECOMMENDATION 3 (Assessment)
We recommend using the FES-I or especially the Short FES-I for assessing concerns about falling in acute care hospitals or long-term care facilities. **GRADE 1B.**

RECOMMENDATION 4 (Interventions)
We recommend exercise, cognitive behavioural therapy and/or occupational therapy (as part of a multidisciplinary approach) to reduce concerns about falling in community-dwelling older adults. **GRADE 1B.**

RECOMMENDATION DETAILS

1. We recommend clinicians adopt a holistic approach, combining concern about falling with balance and/or gait assessment as this will help to put the degree of concern in context, when assessing older adults in the community. Concerns about falling – or the closely related notion of fear of falling – shows heterogeneous results in predicting future falls in the community. The rationale for including concerns about falling as part of a multifactorial falls risk assessment is that this is a measure of an older adult's perceptions about the falls they have experienced, the impact falls have had on their quality of life, their openness to various interventions (e.g. an older adult inappropriately very fearful of falling may be reluctant to increase their physical activity and follow an exercise programme if this is not dealt with), and as a treatment outcome in a subset of older adults.
2. The Falls Efficacy Scale International (FES-I) and the Short Falls Efficacy Scale International (Short FES-I) have a strong to moderate level of evidence for their use in older adults living in the community. There is evidence from a recent systematic review and meta-analysis of 59 studies that the FES-I and Short FES-I are reliable and valid tools when used with both healthy older adults and those with conditions that put them at a greater risk of a fall (e.g. multiple sclerosis, stroke, vestibular disorders, PD) [1]. Both instruments demonstrate good internal consistency, test-retest reliability, inter-rater reliability and construct validity in these populations [1].
3. FES-I and short FES-I are regularly used in acute hospital and long-term care facility populations. Preliminary research from a systematic review of measurement properties suggests that FES-I has excellent internal consistency (evidence from five studies) and test-retest reliability (evidence from two studies), as well as good construct validity (evidence from seven studies) when used in hospital inpatient or care home settings [1] Short FES-I also showed excellent internal consistency (evidence from two studies) and good construct validity (evidence from two studies) when used with hospital inpatients [1] Short FES-I may be more suitable for use with inpatients and in residential care settings due to its brevity (7 items) [1].
4. Different types of interventions can be effective in reducing concerns about falling, such as exercise interventions [2-4], cognitive behavioural therapy [5, 6] and occupational therapy [7], with small to moderate effect sizes. Two recent systematic reviews highlighted that supervised holistic exercise interventions in community settings, such as Pilates or yoga, had the largest effect sizes in reducing concerns about falling compared with other interventions [3, 4].

PRACTICAL TIPS

1. FES-I and Short FES-I are available free of charge in over 30 languages from www.fes-i.org and can be self-administered or done as part of a clinical interview.
2. The 7-item Short FES-I can be useful for clinicians for a rapid assessment.
3. Both the FES-I and Short FES-I ask about any concerns about falling adults may have during daily activities.
4. It is relevant to conduct a gait and/or balance assessment in combination with an evaluation of concerns about falling, as this will help to indicate whether the degree of concerns about falling is appropriate or not.
5. Existing fall prevention strategies, i.e. exercise interventions, can reduce concerns about falling in older adults.
6. Cognitive behavioural therapy and occupational therapy interventions can also reduce concerns about falling and should be considered as part of a multidomain fall prevention approach when available.

OBJECTIVE

Step 1: To make evidence-based recommendations through critical appraisal of the existing evidence (systematic review and meta-analysis) on assessments of concerns about falling as part of a comprehensive fall risk assessment of older adults.
Step 2: To make evidence-based recommendations through critical appraisal of the existing evidence (systematic review and meta-analysis) on interventions for concerns about falling as part of a multidisciplinary approach.

SUMMARY OF FINDINGS

The complexity of the terms used for fall-related psychological effects arises from their different underlying constructs. These terms include 'concerns about falling', 'fear of falling', 'anxiety', 'balance-related confidence' and 'self-efficacy'. More recent models are linking anxiety, fear of falling and self-efficacy [8, 9]. While fear of falling is the term used in much of the available peer-reviewed literature, making enquiries about concerns offers advantages to fear of falling. It is 'less intense and emotional (and therefore may be more socially acceptable for older adults to disclose)' [10], while fear has 'psychiatric connotations implying analogy to phobias which may or may not be accurate' [11]. The older adult panel we consulted about the recommendations preferred the term concern over fear. Based on this, we recommend that clinicians use the term concerns about falling when making enquiries. This is also congruent with the wording of the recommended FES-I questionnaires.

Concerns about falling are common, with an estimated prevalence of between 21% to 85% reported in community-living older adults [12]. Our review of clinical guidelines showed that concerns about falling is not consistently recognised and recommended as an essential component of a multifactorial fall risk assessment of older adults. Some guidelines framed these concerns as a consequence of falls and recommended that asking about them should be included as a post-fall assessment [13-15], while others did not include making enquiries about these concerns in their recommendations [16-21]. Three guidelines recommended included assessing concerns about falling as part of a comprehensive evaluation for fall risk in community-dwelling older adults [15, 22, 23], but only one proposed using the FES-I as a screening tool [15].

Our narrative review and expert consensus found that concerns about falling was an inconsistent predictor of future falls. While a number of longitudinal studies found that concerns about falling was predictive of falls or recurrent falls [24-30], other longitudinal research has reported inconsistent findings [31], especially when considering other important covariates such as age and sex [32, 33]. Additional research also highlights that the relationship between concerns about falling and future falls may be a complex one. For instance, Allali et al. reported that concerns about falling predicted future falls only in older adults with

postural instability or gait difficulties [34]. Relatedly, other research suggests the importance of considering concern about falling with respect to an individual's *actual* balance or functional capacity [24, 35]. For individuals with poorer balance or mobility restrictions, concerns about or concerns about falling may actually have a protective effect (i.e. associated with *reduced* risk of future falls) while for individuals with higher functional capacity, the presence of concerns about falling has been associated with an *increased* risk for future falls [24, 35]. The literature suggests that relationship between concerns about falling and future falls is likely dependent on individual physiological fall risk, and therefore is unlikely to be the primary cause of falls in older adults. Nevertheless, several studies have demonstrated that concerns about falling can be excessive or maladaptive. Activity avoidance and reduced engagement in physical activities are commonly observed in adults with concerns about falling [12, 36, 37], which over time can lead to further physical decline and falls [27, 38]. In addition, previous research has suggested that concerns about falling can change how people walk. It can increase the variability of walking movements and cause a so-called 'cautious gait' characterised by shorter stride length and longer double limb support, irrespective of functional capacity [39, 40]. This strategy may reduce walking stability and directly increase fall risk as a result [41].

A recent systematic review and meta-analysis across 59 articles demonstrated good psychometric properties of four variants of the FES-I: 16-item FES-I, 7-item Short FES-I, 30-item Iconographical Falls Efficacy Scale (IconFES), and 10-item Short Icon FES [1]. Internal consistency was good for all FES-I measures. Pooled test-retest and inter-rater reliabilities of the 16-item FES-I and 7-item Short FES-I were excellent. There is evidence for both structural and content validity of the 16-item FES-I. Meta-analysis has demonstrated that the 16-item FES-I has excellent convergent validity with other measures of similar constructs, as well as excellent discriminant validity regarding sex, single item fear of falling, and falls history. Preliminary results suggest good test-retest reliability and validity of the IconFES and Short IconFES; however, the number of studies were limited, and further research is required. Based on this analysis, FES-I versions have excellent reliability and validity and are recommended for research and clinical use.

Concerns about falling in older adults can be managed by a variety of intervention strategies. Exercise interventions [2-4], cognitive behavioural therapy [5, 6] and occupational therapy [7] can be recommended based on a series of systematic reviews and meta-analyses that looked at the effect of these individual interventions on concerns about falling. However, many of these interventions only reach small to moderate effect sizes in trials [2-7]. Based on our expert consensus, we recommend implementing these intervention strategies as part of a multidisciplinary approach. Two recent systematic reviews looked at the individual components of intervention strategies that might be more effective and highlighted that supervised holistic exercise interventions in community settings, such as Pilates or yoga, were significantly associated with a greater reduction in concerns about falling [3, 4]. There is insufficient evidence to make a recommendation on the best combination of interventions to reduce concerns about falling in older adults.

Description of instruments to assess concern about falling

Falls Efficacy Scale International (FES-I)

The person is asked to rate concerns about falling while imagining completing 16 common activities of daily living. Concerns are rated on a 4-point scale ranging from 1=not at all concerned to 4=very concerned [10]. The individual item scores are summed up and a higher total score value indicates a higher concern about falling. Delbaere et al established cut-points for low (≤19), moderate (20-27) and high (≥28) concerns about falling [25].

Short Falls Efficacy Scale International (Short FES-I)

The person is asked to rate concerns about falling while imagining completing 7 common activities of daily living on a 4-point scale rating from 1=not at all concerned to 4=very concerned [10]. The individual item

scores are summed up and a higher total score value indicates a higher concern about falling. Delbaere et al established cut-points for low (≤8), moderate (9-13) and high (14) concerns about falling [25].

Iconographical Falls Efficacy Scale (IconFES)
The person is asked to rate concerns about falling while imagining completing 10 (short version) or 30 (long version) activities of daily living including higher-risk activities such as changing a ceiling light bulb on a 4-point scale rating from 1=not at all concerned to 4=very concerned. The scale uses pictures to facilitate and simplify the environmental context of the questions [26]. Lim et al established cut-points for low (≤40), moderate (41-58) and high (≥59) concerns about falling [29].

Adaptations of the FES-I and Short FES-I
Cultural adaptations: FES-I and Short FES-I have been translated from the original English into many different languages (see: www.fes-i.org) with some resulting in minor cultural adaptations.
Adaptations for different settings: The FES-I and Short FES-I have been validated for use in community-dwelling populations of older adults. There is evidence to recommend concerns about falling assessment tools, especially Short FES-I, for acute care or long-term care [1].

Other tests
While other concerns about falling tools have also been developed, they have been less studied than the preceding instruments and their falls predictive ability have been inconsistent. For these reasons, they cannot currently be recommended as assessment tools [42]. A simple one-item questionnaire has been used with a dichotomous response or a hierarchy of responses. In addition, a wide range of questionnaires on concerns about falling and related constructs (e.g. activity avoidance, balance confidence) have been developed over the years, such as Falls Efficacy Scale [11] and modified Falls Efficacy Scale [43], Activities-Specific Balance Confidence Scale [44], Survey of Activities and Fear of Falling in the Elderly [45], and Consequence of Falling Scale [46].

Multifactorial falls risk assessment
Evidence from the current narrative review demonstrates that it is important to combine different assessment tools to predict falls in older adults and plan fall risk management. Fall risk factors are multi-dimensional ranging from physical to psychological and environmental factors. Concerns about falling assessment tools when used alone show weak to moderate ability to predict future falls. It is our consensus opinion, though, that there are important reasons to include a concern about falling tool in the assessment of older adults who fall for reasons other than predicting the future risk of falls. Concerns about falling tools should therefore be integrated into a holistic toolkit for the assessment of older adults who have fallen and/or are at risk of falling.

Outcome assessment following intervention
Evidence suggests that fall prevention programmes, especially exercise interventions in community-dwelling older adults, can reduce concerns about falling without increasing the risk of falls [2]. The assessment of concerns about falling by valid, reliable, and sensitive tools should be considered as part of a core set of outcomes for all fall prevention trials.

Description of effective interventions to reduce concerns about falling
Evidence from systematic reviews and meta-analyses demonstrates that concerns about falling can be reduced. However, most interventions only result in small to moderate effects in reducing concerns about falling that are short-lived. The strongest evidence is for exercise interventions (which are described in detail by the recommendations the WG on exercise have made) [47]. A recent review concluded that interventions with characteristics including holistic exercises (i.e. Pilates, ving tsun, yoga, tai chi), supervision by a tai chi instructor, or delivered in the community setting were more effective at reducing concerns about falling in

older adults than interventions without these elements in the short-term [4]. In contrast, home-based delivered interventions or tailored written materials were less effective in reducing concerns about falling [4]. While this might suggest a need for a social element, there is no evidence to support this as yet. A follow-up analysis confirmed that interventions with holistic exercise, meditation, or body awareness were significantly more effective than interventions without these components [3]. There is also evidence to show that cognitive behavioural therapy (CBT) interventions alone and CBT-based multicomponent interventions (i.e. physical activities combined with psychotherapeutic strategies) have shown small-to-moderate sustained reductions in concerns about falling in community-dwelling older adults [5, 6]. Finally, occupational therapy when used as part of a multidisciplinary approach might also be effective in community-dwelling physically frail older adults [7]. Another aspect of an effective intervention would be the level of training of the exercise instructors, as most effective exercise interventions were led by specially trained professionals.

JUSTIFICATION

Evidence for our recommendations on the best tool to evaluate concerns about falling and best interventions to address concerns about falling have emerged from a range of systematic reviews and meta-analyses. There is at best moderate evidence that concerns about falling are predictive of future falls, which is not supported by systematic review evidence. Our expert opinion is that concerns about falling is unlikely to be the primary cause of falls in older adults, and that the relationship between concerns about falling and future falls is likely dependent on individual physiological fall risk.

SUBGROUP AND SETTINGS CONSIDERATIONS

1. FES-I and Short FES-I are important measures in the comprehensive assessment of community-dwelling older adults who have fallen and/or are at risk for falling for the purposes of developing risk profiles and informing management [35]. FES-I and Short FES-I have also been validated in adults with mild to moderate cognitive impairment [48] and early stage dementia [47], as well as other conditions associated with an increased risk of falls [48-54] (e.g. Stroke, MS, and Parkinson's disease).
2. Concerns about falling should be managed where possible through a multidisciplinary fall prevention approach that includes exercise, cognitive behavioural therapy and/or occupational therapy interventions. Most studies have included exercise and were conducted in community settings [3, 4]. There is insufficient evidence to provide insight into whether a certain subgroup might be more or less likely to benefit from these interventions.

IMPLEMENTATION CONSIDERATIONS AND TOOLKITS

1. FES-I and in particular the short FES-I are suitable tests that can be implemented in the standard clinical evaluation of older adults due to its ease and efficiency of administration, low cost, and reliability.
2. Older adults who present with concerns about falling should be offered an exercise programme as a minimum, but ideally a multidisciplinary approach including exercise as well as cognitive behavioural therapy and/or occupational therapy interventions.

MONITORING AND EVALUATION

For monitoring the effectiveness of interventions to reduce concerns about falling, it is important to use validated scales. A recent systematic review on the measurement properties of the FES-I found sufficient evidence for the responsiveness of the FES-I [1]. The majority of effect sizes reported across five studies supported pre-defined hypotheses regarding the expected magnitude of change, suggesting its usefulness as a monitoring and evaluation tool. There is inconsistent evidence regarding the responsiveness of the Short FES-I.

RESEARCH PRIORITIES

1. Preferred tools for assessing concerns about falling need to be defined for different settings (e.g. community, outpatient clinic, acute care, long-term care), older adults with specific clinical characteristics (e.g. cognitive impairment, stroke, Parkinson's disease) and different levels of functional status. A review of FES-I measurement characteristics in sub-populations would be a timely first step.
2. Meaningful cut-off points for FES-I need to be confirmed across larger samples of community-dwelling older adults and need to be established for older adults with specific clinical characteristics (e.g. cognitive impairment, stroke, Parkinson's disease) and different levels of functional status.
3. Further research is also recommended to establish the minimally important and clinically meaningful change of the FES-I.
4. The predictive ability of concerns about falling for falls, injurious falls, and restriction of daily activities need to be confirmed, as well as the mediating effect of related constructs (e.g. anxiety, depression, social isolation, self-efficacy) in these relationships.
5. More research is needed on the understudied components of potentially effective interventions on concerns about falling in community and care settings to properly investigate their effectiveness, such as the effect of hip protectors on concerns about falling.
6. Exercise and cognitive behavioural therapy are effective as individual interventions with small to moderate effects. Future research should evaluate whether a combination of potentially effective interventions can have larger effects on concerns about falling.
7. Finally, long-term follow-ups are necessary to evaluate which intervention strategies have lasting effects on concerns about falling.

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Ad hoc Expert Group 1
Dizziness and Vestibular disorders and Falls

Expert recommendation. Routinely ask about dizziness symptoms, and undertake follow-up assessment as necessary to identify cardiovascular, neurological and/or vestibular causes. **GRADE: E.**

Dizziness is a common complaint in older adults who fall, with different meanings between individuals, and often no single explanatory cause. Careful history taking is of particular importance. Presyncope and observable unsteadiness or ataxia may be present.

The vestibular system has a key role in the control of posture and gait, and there is evidence of a high incidence of both benign paroxysmal positional vertigo (BPPV) and vestibular dysfunction in those presenting with falls [1-4]. In younger adults, such disorders can often be identified in the clinical history by a reported sensation of vertigo with clear positional or motion-provoked triggers. Identifying cases of vestibular dysfunction is more challenging in older adults due to more variable symptoms. Where vertigo is reported, positional tests should be used to identify cases of BPPV from non-cases (e.g. Dix-Hallpike, Head Impulse Test); however, the sensitivity of case-finding algorithms based purely upon symptoms compared with screening with positional testing in older adults is unknown.

Particle repositioning manoeuvres are an effective treatment for BPPV [5], and vestibular rehabilitation therapy (VRT) improves postural and gait stability in cases of vestibular dysfunction [6]. Such treatments are low-cost and can therefore be applied in both developed and developing healthcare ecosystems. Although there is some evidence that these exercise-based therapeutic interventions can reduce falls risk [7, 8], such evidence is limited. However, as the risk of harm are low and improvements in health-related quality of life are potentially high, therapeutic interventions should always be sought where BPPV or vestibular dysfunction are identified. These treatments require trained staff but are low-cost and could be potentially applied in low resource settings.

Research Recommendations:

1. BPPV and Falls Prevention

What is the best case-finding approach for identifying BPPV in those at risk of falls? What is the effectiveness of particle repositioning manoeuvres in reducing falls risk in adults with BPPV?

2. Vestibular Dysfunction and Falls Prevention

What is the best case-finding approach for identifying vestibular dysfunction in those at risk of falls? What is the effectiveness of vestibular rehabilitation therapy in reducing falls risk in adults with vestibular dysfunction?

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Ad hoc Expert Group 2
Vision, Hearing and Falls

Vision

Expert recommendation. Enquire about vision impairment as part of a multifactorial falls risk assessment, measure visual acuity and examine for other visual impairments such as hemianopia and neglect where appropriate. **GRADE: E.**

Impaired vision is an important and independent risk factor for falls in older people who live in the community. Vision loss is the third most common chronic condition in older adults, and about 20% of people aged 70 years or older have a visual acuity of less than 6/12. Many older people who wear spectacles with outdated prescriptions or no spectacles at all would benefit from wearing new spectacles with the correct prescription. This indicates the importance of regular eye examinations to prevent vision-related impairment and improve quality of life. Visual screening should not be limited to measurement of visual acuity and should incorporate contrast sensitivity and depth perception. Evidence from randomised controlled trials and prospective studies indicates cataract surgery for the first eye [1] and both eyes [2] and achieving optimal safe functional vision by active older adults avoiding the wearing of multifocal glasses when outside [3] are effective fall prevention strategies. Occupational therapy interventions involving home hazard reductions are also effective in preventing falls in older people with severe visual impairments [4]. Although interventions involving vision assessment and provision of new spectacles undoubtedly improve performance in visual tests in community-dwelling older adults, such interventions have not yet been shown to reduce the risk of falls [5]. In fact, it is recommended that optometrists counsel their clients about likely short term increased fall risk when dispensing new prescription glasses.

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Hearing

Expert recommendation. Enquire about hearing impairment as part of a multifactorial falls risk assessment, measure and examine for hearing impairments and refer to a specialist where appropriate. **GRADE: E.**

Impaired hearing is an independent risk factor for falls in older adults [1, 2]. Possible explanations for the association between hearing loss and falls include coexistent vestibular pathology that increases fall risk, reduction in cognitive capacity for maintaining balance given the cognitive load of hearing loss and a loss of auditory perception leading to reduced spatial awareness [3, 4]. Hearing loss itself is a highly prevalent condition among older adults that can be readily treated with amplification. Accessibility to hearing and visual assessments in LMIC should be enhanced and their additional benefit of falls prevention should be emphasised.

Falls risk may be reduced by increasing the use of hearing aids and/or supporting older people with hearing impairment to develop and maintain safe mobility in their environment, although these strategies have not been evaluated in fall prevention randomized controlled trials.

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Ad hoc Expert Group 3
Environment and Falls

Strong recommendation. Identification of an individual's environmental hazards where they live and an assessment of their capacities and behaviours in relation to them, by a clinician trained to do so, should be part of a multifactorial falls risk assessment. **GRADE 1B.**

Strong recommendation. Recommendations for modifications of an older adult's physical home environment for fall hazards that consider their capacities and behaviours in this context, should be provided by a trained clinician, as part of a multidomain falls prevention intervention. **GRADE 1B.**

Environmental factors are important in many falls. Environmental risk factors are influenced by the interaction between A person's exposure to environmental fall hazards (such as slippery stairs, poor lighting at entrances, lack of grab rail), risk taking behaviour (such as clutter in walkways, unsafe climbing on chairs or ladders) and their physical capacity [1-3]. Interventions to reduce fall-hazards in and about the home can reduce the rate of falls and the number of experiencing a fall [4]. The greatest reductions are seen when the intervention is delivered to those at higher risk of falling. Environmental assessment should be offered to older adults assessed as at high falls risk, such as older persons with a history of falling in the past year [5, 6] and an impairment in daily living activity [7, 8] or recently hospitalised from a fall [9], and those with severe vision impairment [10].

Evidence from randomised trials also provides evidence that the intervention is more effective when the aim of the visit, the assessment process and the intervention are highly tailored to falls, the outcome of interest [4]. It is also more likely effective when delivered by an occupational therapist [4]. A quality home fall-hazard intervention is expected to meet a number of crucial elements [11-13]. For example, the randomised trial by Pighills et al [8] illustrated that more recommendations (mean 3.8) were provided by the occupational therapists than the trained domiciliary workers (1.6). Assessment by a clinician trained to do so (e.g. occupational therapists) needs to include the assessment of environmental hazards, capacities and behaviours of the individual and an understanding of the effect of the environment on function [13, 14]. Other elements considered crucial are using an assessment tool validated for the broad range of home fall-hazards and fall risk assessment along with consideration of the functional capacity of the person (including habitual behaviours, functional vision, cognition and mobility) within the context of their environment [13, 14]. Recommended assessment tools for hazards are the Westmead Home Safety Assessment and the Falls Behavioural Scale for the Older Person [11, 12]. Training is recommended, as an occupational therapy home visit with a focus on fall outcomes is different than those for access and independence.

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Ad hoc Expert Group 4
Vitamin D and Nutrition and Falls

Expert recommendation. Assess nutritional status including vitamin D intake as part of a multifactorial falls risk assessment, followed by supplementation where appropriate. **GRADE: E.**

Nutritional assessment is an important part of the multifactorial falls risk assessment and should include assessment of adequate vitamin D intake and serum 25(OH) vitamin D levels, when appropriate, and substance abuse and excessive alcohol intake as well. A recent systematic review showed that both nutritional status and body mass index (BMI) are associated with the risk of falls in community-dwelling older adults. In particular, being at risk of malnutrition or being malnourished may increase the risk of a fall. BMI showed a U-shaped association with the risk of falls, and BMI values between 24.5 and 30.0 were associated with the lowest risk of fall [1]. Poor nutritional status can be both a consequence of underlying morbid conditions and a causal factor of pathological ageing process and higher mortality. Underweight and undernourished individuals may both have increased risk of falls due to sarcopenia, impaired mobility and walking instability, as well as worse functional and clinical status. On the other hand, excess weight in obese people may also have a negative impact on postural stability, self-sufficiency, and physical activity, all factors that may be associated with the falls [1]. Malnutrition assessment can be performed by using validated tools, such as the Mini Nutritional Assessment (MNA).

If older adults are considered at risk of deficiency, daily vitamin D supplementation should be recommended in accordance with national nutrition guidelines, but current evidence does not support universal vitamin D supplementation for preventing falls. Vitamin D supplementation of ≥1,000 IU daily did not reduce falls in older community dwelling adults who achieved mean 25(OH)vitamin D levels of ≥30 ng/ml versus those with levels <30 ng/ml [2]. The key is to target its use in a manner that will confer benefit. Many studies on vitamin D supplementation and outcomes lack information on 25(OH)vitamin D levels, thereby limiting definitive conclusions about the actual benefit of vitamin D supplementation. Very frail individuals and those living in care homes are more likely to be frankly vitamin D deficient, and these are the individuals in whom supplementation is most likely to yield benefits. There is evidence that vitamin D can prevent falls in residential care, probably because levels are very low among residents [3]. Recent evidence from the VITAL trial [4] shows that 2,000 or 4,000 IU daily is not harmful. For older adults at increased risk for vitamin D deficiency it is still reasonable to take 800–1,000 IU vitamin D per day, following established international recommendations. However, 25(OH)vitamin D levels less than or equal to 12 ng/ml should be treated with 50,000 IU weekly for 8 to 12 weeks, and subsequent vitamin D supplementation should be based upon re-assessment of the 25(OH)vitamin D level.

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Ad hoc Expert Group 5
Depression and Falls

Expert recommendation. Enquire about depressive symptoms as part of a multifactorial falls risk assessment, followed by further mental state assessment if necessary and referral to a specialist where appropriate. **GRADE: E.**

Depression is a common and important cause of morbidity and mortality in older adults worldwide, affecting around 10–15% of community-dwelling older adults. If left untreated, symptoms may persist for years. Both untreated depression and antidepressant use contribute to fall risk [1, 2]. For details on fall risk and antidepressant use we refer to the outcomes and recommendations of WG 2 (fall-risk increasing drugs, FRIDs). Untreated depression is independently associated with increased fall risk: a meta-analysis showed a 37% of increased risk [1]. The pathophysiologic mechanisms underlying the association between depression and falling are complex. Major mechanisms are psychomotor retardation, deconditioning, gait and balance abnormalities, impaired sleep, and impaired attention. Often, multiple pathways interact and co-occur. Also, excessive concern about falling contributes to increased fall risk in depressed older adults. It negatively influences gait and balance and thereby increases tendency to fall [2]. Antidepressants are FRIDs and contribute to (or cause) falling through causing sedation, impaired balance/reaction time, OH, hyponatremia, cardiac conduction delay/arrhythmia, and/or drug-induced Parkinsonism [2]. Screening for depression as a risk factor for falls should be considered in older individuals in LMIC. Strategies to raise awareness and reduce stigma of depression and mental illness are needed in these countries. However, longitudinal and interventions studies are required before firm recommendations can be made in this area.

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Ad hoc Expert Group 6
Frailty and Falls

Frailty is associated with an increased falls risk. Frailty is a state of increased vulnerability for developing dependency or mortality when exposed to a stressor. The prevalence for frailty is approximately 15% in the over 65 years of age group rises to more than 25% in those aged over 85 years, although the prevalence varies according to the definition and diagnostic methods used and the population studied [1]. A recent systematic review showed that frailty doubles the risk of suffering recurrent falls while being pre-frail increases this risk by 30% [2]. Frailty has been also associated with more injuries due to falls and hip fractures. As previously noted, our falls stratification algorithm includes frailty as marker of higher fall risk. A task force of the International Conference of Frailty and Sarcopenia (ICFSR) has developed international clinical practice guidelines for the identification and management of physical frailty [1].

Further work is required to develop consensus on how to incorporate the frailty concept into management of older fallers and whether such an approach will reduce the risk of falls. Due to the association between frailty status and gait speed, the latter could potentially be considered a proxy of frailty [3]. The “Clinical Frailty Scale” [4] is semi-quantitative scale with pictograms with scores ranging from 1 (very fit) to 9 (terminally ill) and it is an accepted proxy of gait speed, as a score of 5 or higher (i.e. classified as being frail) is associated with a gait speed below 0.8 m/s. Further studies are needed to assess the potential added value of using frailty as a proxy for intermediate to high fall risk and an entry point for personalised multifactorial falls risk assessment. From an implementation point of view, such an approach is promising as it would enable direct linkage to existing services and care pathways that opportunistically screen for frailty in the general older population.

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Ad hoc Expert Group 7
Sarcopenia and Falls

Sarcopenia is a condition characterised by an age-associated loss of skeletal muscle mass and strength/function but also associated with low physical activity levels, and an increased risk of falls in older adults. The prevalence of sarcopenia and its association with falls varies according to the diagnostic definition used and the population studied. In the longitudinal iLSIRENTE study, the prevalence of sarcopenia was approximately 25% in people aged 80 years and above, and participants with sarcopenia were three times more likely to fall during a follow up period of 2 years [1]. International clinical practice guidelines exist for the screening, diagnosis, and management of sarcopenia [2, 3]. A growing number of clinicians and researchers advocate paying more attention to diagnosing and treating sarcopenia in older people identified as being at a high risk of falls, although further research is required on how this should be conducted and whether applying non-exercise interventions for sarcopenia such as protein supplementation will reduce falls.

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Ad hoc Expert Group 8
Delirium and Falls

Delirium, cognitive impairment and dementia and are independent risk factors for falls in older adults in hospital settings, residential aged care, at home and in the community [1]. The key to preventing falls in older adults with these conditions is to deliver evidence-based, person-centred care. When delirium, dementia and cognitive impairment are managed well, falls are less prevalent [2]. Adapting the environment to promote safety and educating caregivers in strategies for safe mobility can also be of benefit in older adults with delirium. There is some evidence that staff education can help to reduce falls of hospitalised older adults experiencing delirium [3, 4]. Multidomain strategies which have been shown to reduce the risk of delirium include cognitive stimulation, daily orientation, early mobilisation, vision and hearing, fluid management, constipation management, feeding assistance, sleep and family involvement [5, 6]. At present, there is evidence that these strategies might reduce falls, therefore they should be considered as part of a comprehensive care package for older adults in hospital. Promoting mobility to maintaining independence is important, yet there is a tension that needs to be managed between promoting mobility and preventing falls, especially in very frail older adults [7].

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Ad hoc Expert Group 9
Pain and Falls

Expert recommendation. Enquire about pain as part of a multifactorial falls risk assessment, followed as indicated by a comprehensive pain assessment. **GRADE: E.**

Expert recommendation. Adequate pain treatment should be considered as part of the multidomain approach. **GRADE: E.**

Recommendation detail

A personalised approach that takes into account both non-pharmacological and pharmacological options is necessary, to minimise risk of adverse events.

Pain is an established risk factor for falling [1, 2]. Symptoms of pain are common in older adults, with over 60% of community dwelling older adults reporting pain, mostly in multiple sites [3]. The most prevalent condition resulting in pain is arthritis, which is an independent risk factor for falling [1]. Other chronic conditions resulting in pain in older adults include diabetic complications, cancer-related pain and post-stroke pain [4]. A comprehensive pain assessment is needed to guide appropriate management. This includes defining its cause, type (nociceptive, neuropathic) and intensity by using a pain rating scale designed for older adults [5]. A proactive and structured approach is important, as there is underreporting in older adults due to among others sensory impairments and cognitive impairments [6].

For prevention of falls, adequate pain treatment is warranted. Both non-pharmacological (physiotherapy, cognitive behavioural therapy) and pharmacological approaches need to be considered [7, 8]. Some analgesics, in particular opioids, increase fall risk [9]. The mechanisms of fall risk associated with opioids in older adults include sedation, orthostatic hypotension, and hyponatremia [9]. Therefore, while the STOPP/ START criteria suggest use of opioids for severe pain or when paracetamol and NSAIDs are ineffective [10] , these potential adverse effects need to be anticipated, identified and managed. Weak opioids are preferably avoided, as the adverse events risk may outweigh the benefit [9]. For neuropathic pain, first line treatment includes serotonin norephinephrine reuptake inhibitors, gabapentinoids and transdermal lidocaine or capsaicin [11]. For all analgesics, it is advisable to start slow, go slow and monitor efficacy and adverse effects. For general deprescribing recommendations we refer to WG2 recommendations.

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Ad hoc Expert Group 10
Urinary symptoms and incontinence and Falls

Expert recommendation. Enquire about urinary symptoms as part of a multifactorial falls risk assessment **GRADE: E.**

Both urinary incontinence and falls are recognised as "geriatric syndromes" [1]. Previous epidemiological studies have shown contradictory results on whether urinary incontinence and lower urinary tract symptoms (LUTS) in older adults are associated with falls. A recent comprehensive systematic review and meta-analysis included 38 articles (total participants 230,129) and found that urinary incontinence was significantly associated with falls (OR, 1.62; 95% CI, 1.45–1.83) [2]. Subgroup analyses based on the age and sex of the participants revealed a significant association between urinary incontinence and falls in older (≥65 years) participants (OR, 1.59; 95% CI, 1.31–1.93), and in both men (OR, 1.88; 95% CI, 1.57–2.25) and women (OR, 1.41; 95% CI, 1.29–1.54) [2].
Previous studies have suggested that urgency type urinary incontinence, but not stress type urinary incontinence, are associated with falls. However, a subgroup analysis showed that a significant association between urinary incontinence and falls was observed in older adults with both urgency urinary incontinence (OR, 1.76; 95% CI, 1.15–1.70) and stress urinary incontinence (OR, 1.73; 95% CI, 1.39–2.15) [2]. A recent systematic review and meta-analysis also showed that nocturia is associated with a 1.2-fold increased risk of falls and possibly a 1.3-fold increased risk of fractures [3].
The 3IQ screening questions for urinary incontinence can help to differentiate between stress, urge and mixed types of incontinence [4].

The 3IQ includes the following questions:

1. During the last three months, have you leaked urine (even a small amount)? - (Yes/No)- if No stop here.
2. During the last three months, did you leak urine (check all that apply):
    a. When you were performing some physical activity, such as coughing, sneezing, lifting, or exercise?
    b. When you had the urge or feeling that you needed to empty your bladder, but you could not get to the toilet fast enough?
    c. Without physical activity and without a sense of urgency?
3. During the last three months, did you leak urine most often (check only one):
    a. When you are performing some physical activities, such as coughing, sneezing, lifting, or exercise?
    b. When you had the urge or feeling that you needed to empty your bladder, but you could not get to the toilet fast enough?
    c. Without physical activity or a sense of urgency?
    d. About equally as often with physical activities as with a sense of urgency?

There is a need for further studies investigating the mechanisms of how UI is associated with falls. There have been very few studies investigating whether interventions to treat UI can reduce falls. A systematic review of the literature evaluated the effect of any type of continence management strategy on falls in older adults and found only four articles met their inclusion criteria. Two studies were randomised controlled trials, one a retrospective cohort study and one an uncontrolled intervention study. Interventions included pharmacological agents, a toileting regime combined with physical activity and an individualised continence programme. Only one study that evaluated the combination of physical activity and prompted voiding found an effect on falls [5].
Further research is required to assess the impact of continence management on falls to identify if measures such as bladder training, timed or prompt voiding, pelvic floor exercises, pharmacotherapy, improving mobility to get to the bathroom and environmental modifications (e.g. a bedside commode) may decrease the incidence of falls.

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