



# FALLS PREVENTION AMONG OLDER ADULTS LIVING IN THE COMMUNITY

HPB-MOH Clinical Practice Guidelines  
1/2015



Academy of Medicine,  
Singapore



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College of Physicians



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MINISTRY OF HEALTH  
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# Levels of evidence and grades of recommendation

## Levels of evidence

Levels	Type of Evidence
1 <sup>++</sup>	High quality meta-analyses, systematic reviews of randomised controlled trials (RCTs), or RCTs with a very low risk of bias.
1 <sup>+</sup>	Well conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias.
1 <sup>-</sup>	Meta-analyses, systematic reviews of RCTs, or RCTs with a high risk of bias.
2 <sup>++</sup>	High quality systematic reviews of case control or cohort studies. High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal.
2 <sup>+</sup>	Well conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal.
2 <sup>-</sup>	Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal.
3	Non-analytic studies, e.g. case reports, case series
4	Expert opinion

## Grades of recommendation

Levels	Type of Evidence
A	At least one meta-analysis, systematic review of RCTs, or RCT rated as 1 <sup>++</sup> and directly applicable to the target population; or A body of evidence consisting principally of studies rated as 1 <sup>+</sup> , directly applicable to the target population, and demonstrating overall consistency of results.
B	A body of evidence including studies rated as 2 <sup>++</sup> , directly applicable to the target population, and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 1 <sup>++</sup> or 1 <sup>+</sup>
C	A body of evidence including studies rated as 2 <sup>+</sup> , directly applicable to the target population and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 2 <sup>++</sup>
D	Evidence level 3 or 4; or Extrapolated evidence from studies rated as 2 <sup>+</sup>
GPP (good practice points)	Recommended best practice based on the clinical experience of the guideline development group.

CLINICAL PRACTICE GUIDELINES

**FALLS PREVENTION AMONG  
OLDER ADULTS  
LIVING IN THE COMMUNITY**

HPB-MOH Clinical Practice Guidelines 1/2015

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## Statement of Intent

These guidelines are not intended to serve as a standard of medical care. Standards of medical care are determined on the basis of all clinical data available for an individual case and are subject to change as scientific knowledge advances and patterns of care evolve.

The contents of this publication are guidelines to clinical practice, based on the best available evidence at the time of development. Adherence to these guidelines may not ensure a successful outcome in every case. These guidelines should neither be construed as including all proper methods of care, nor exclude other acceptable methods of care. Each physician is ultimately responsible for the management of his/her unique patient, in the light of the clinical data presented by the patient and the diagnostic and treatment options available.

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## Foreword

Falls and injuries related to falls are common among older adults. Globally, one in three adults above 65 years old falls once a year. Falls are not only associated with greater morbidity and mortality in the older population, but are also linked to reduced overall functioning and with early admission to long-term facilities. Reducing falls risk in older adults is therefore an important public health objective.

In Singapore, falls are a leading cause of injury among older adults. According to the National Registry of Diseases Office (NRDO) of Singapore, the crude incidence rate of unintentional falls in year 2012 was 277.7 per 100,000 for adults aged 60 years and older. The incidence rate increases sharply with age. Many of these falls happen at home. Therefore, steps must be taken so that factors which cause a person to fall are reduced or removed.

This Clinical Practice Guidelines on Falls Prevention among Older Adults Living in the Community incorporates the best available evidence from the scientific literature and provides practical recommendations relevant to the local context with the aim to assist all healthcare professionals in the identification and prevention of falls in older adults in the community to help improve quality of life.

**ASSOCIATE PROFESSOR BENJAMIN ONG**  
*DIRECTOR OF MEDICAL SERVICES*  
*MINISTRY OF HEALTH*

## Foreword

With an ageing population, there will be more episodes of older adults falling either in the community or the hospital. While a proportion of these falls will be of minor consequence to the older adults e.g. a bruise, some falls, however, will incapacitate the older adults and reduce their functional independence as they go about their daily living. Many of the falls are also preventable and the situation where these falls occur predictable based on analysis of falls worldwide. We need to translate this understanding on falls into an integrated clinical and public health approach to prevent falls among our older Singaporeans.

The development of Clinical Practice Guidelines (CPG) is a key strategy introduced to build the capacity of health professionals to guide their practice. This first CPG on Falls Prevention in the community provides a step-by-step approach to health professionals to identify older adults who are at risk of falls and to deliver evidence-based recommendations on falls prevention. This guideline was produced with the health care workers in mind, including geriatricians, psychologists, pharmacists, occupational therapists, physiotherapists and nurses.

I would like to take this opportunity to thank the panel of health experts drawn from different specialties who have selflessly contributed their expertise and time to the development of these Guidelines. We hope that the guidelines will prove useful for all in their daily practice.

**MR ZEE YOONG KANG**  
*CEO, HEALTH PROMOTION BOARD*

## Executive Summary of Key Guideline Recommendations

Details of recommendations can be found in the main text at the pages indicated.

### Falls Risk Assessment

**GPP** All older adults (65 years old and older) during a healthcare encounter should be asked for history of falls, and gait and balance problems. (pg 10)

**GPP**

**D** Older adults who have fallen more than once in 6 months or with gait and balance deficits should be offered a comprehensive falls assessment. (pg 10)

**Grade D, Level 3**

### Single Interventions

#### **Exercise interventions**

**A** Exercise programmes for falls prevention should consist of at least a twice-weekly programme for more than 25 weeks, with each session lasting for 60 minutes.<sup>1,2</sup> (pg 13)

**Grade A, Level 1+**

**A** Exercise intensity can be pegged at a moderate level. These exercises should be progressive and individualised to maximise the effectiveness of the programme. (pg 14)

**Grade A, Level 1+**

**A** Exercises should consist of a mix of balance and coordination training, lower limb strengthening (such as strengthening exercise for hip muscles, knee extensors and ankle plantar flexors), endurance and flexibility training. (pg 14)

**Grade A, Level 1+**

#### **Home modification**

**B** Older adults assessed to have a high risk of falls, history of falls or those with visual impairment should be referred to occupational therapists for home assessment and modification intervention. (pg 15)

**Grade B, Level 1+**

## Footwear

**D** Older adults should be advised to wear well-fitting shoes with low heeled, slip resistant soles and a large contact area to reduce falls. (pg 15)

Grade D, Level 4

## Medication review and modification

**B** Medication review and modification to optimise medication use should be provided by the primary care physician in collaboration with a pharmacist (if available), clinical specialist (s) (in cases where specific medications are prescribed by them), the individual older adult and his/her primary caregiver where applicable, for older adults who are taking medications that can increase their risk for falls. This can be performed either as a single intervention or part of a multi-factorial intervention. (pg 16)

Grade B, Level 1+

**B** Psychotropic medications (benzodiazepines and antipsychotics) should be discontinued in older adults (if possible) to prevent falls. This should be done with appropriate tapering of dose, close monitoring of outcomes and input from clinical specialists if necessary. (pg 16)

Grade B, Level 1+

## Vitamin D supplementation

**D** It may be helpful to give vitamin D supplementation to older adults if their vitamin D level is less than 20 ng per millilitre (50 nmol per litre), if higher levels cannot be achieved via sunlight or dietary supplementation.<sup>3</sup> Older adults with significant renal impairment will benefit from treatment with analogues of vitamin D (alfacalcidol or calcitriol). (pg 17)

Grade D, Level 4

**B** Avoid the use of high dose cholecalciferol (500,000 IU per year).<sup>4</sup> (pg 17)

Grade B, Level 1+

## Improving vision

**GPP** Older adults who have impaired vision should be referred for further evaluation of the cause of impairment. (pg 18)

GPP

**B** Persons with cataract as the main cause of vision impairment should be referred for cataract surgery (especially for first eye). (pg 18)

**Grade B, Level 1+**

### **Cardiac pacemaker insertion**

**B** Older adults with suspected cardiogenic falls should be referred to the cardiologist for further evaluation. Cardiac pacing is recommended for patients with cardioinhibitory carotid sinus hypersensitivity and a history of falls. (pg 18)

**Grade B, Level 1+**

### **Education interventions**

**GPP** Provide basic information on falls and educate older adults on the benefits of falls prevention strategies in preventing falls and maintaining independence. (pg 19)

**GPP**

### **Multiple Interventions**

**B** Older adults at risk of falls should be considered for referral to falls prevention programmes consisting of exercise and other interventions, if such programmes are available and accessible. (pg 19)

**Grade B, Level 1+**

### **Multi-factorial Interventions**

**B** Older adults assessed to be at high risk of falls should receive interventions targeted at the individually identified risk factors. (pg 19)

**Grade B, Level 1+**

# 1. Introduction

The Health Promotion Board (HPB) has developed the Clinical Practice Guidelines on Falls Prevention among Older Adults Living in the Community to provide health professionals in Singapore with evidence-based assessments and interventions for falls prevention.

## 1.1 Objectives of guidelines

The aim of these guidelines is to assist health professionals to identify and assess falls risk status of older adults living in the community and to deliver evidence-based interventions for falls prevention.

## 1.2 Target users

The guidelines are intended for all health professionals, including doctors, psychologists, pharmacists, dieticians, optometrists, social workers, occupational therapists, physiotherapists and nurses, to assist them in the assessment and prevention of falls in older adults.

## 1.3 Epidemiology

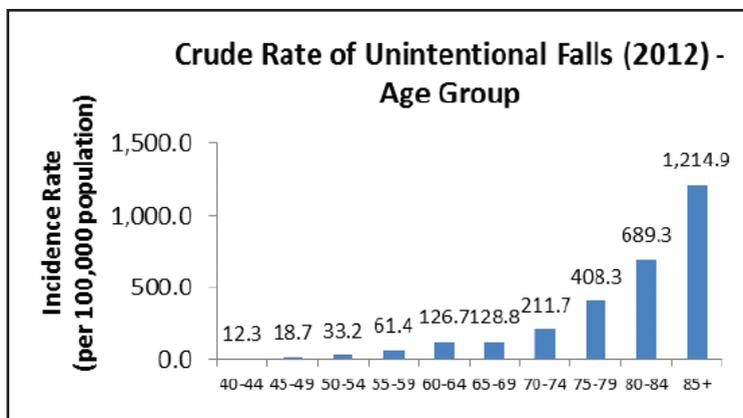
### 1.3.1 Definition of Falls

This set of clinical practice guidelines has adopted a broader definition in order to be more sensitive in identifying falls in older adults, and has defined a fall as “a sudden, unintentional change in position causing an individual to land at a lower level (either on an object or on the floor) other than as a consequence of overwhelming external force.”

### 1.3.2 Incidence of falls

According to the National Registry of Diseases Office (NRDO)<sup>5</sup> of Singapore, the crude incidence rate of unintentional falls in year 2012 was 277.7 per 100,000 for adults aged 60 years or older. The incidence rate increases sharply with age (Figure 1). The majority of falls (63%) occur at home.

Figure 1: Crude Rate of Unintentional Falls\*



Source: National Registry Disease Office, Singapore. 2014.

58% (1,448) of unintended falls occurred among adults aged 65 years or older according to the National Trauma Registry Report,<sup>6</sup> in year 2012.

A local retrospective study conducted by Chan and colleagues (1997)<sup>7</sup> found a one-year falls incidence rate of 17.2 per 100 in adults aged 60 years and above living in the community (n=332). Of those who fell, two-thirds (67%) had a single fall and one-third (33%) had recurrent falls in the past one year.

In summary, fall risk is relatively high. Asian studies, including local ones, suggest that at least 20% of older adults (65 years and above) would fall in a year.

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\* Unintentional falls includes all falls except those above 65 years old with fractured neck of femur.

### *Falls in Asians compared to other ethnic groups*

There is some data from Western countries that there are ethnic differences to fall injury rates, with higher rates in whites compared to people of Asian ethnicity.<sup>8</sup> It is believed that the prevalence of osteoporosis (which is higher in white populations than in Asian populations) may explain some of these differences.

#### 1.3.3 Risk factors

Key factors that have been identified include:

##### a) Socio-demographic factors

Age is the main risk factor, with older adults at higher risk. There appear also to be ethnic and gender differences. Asians in general have lower risk compared to other ethnic groups, while females appear to be at higher risk. Living alone and being single or widowed are also associated with higher fall risk.

##### b) Past medical history

A past history of a fall is a significant predictor of future fall risk. Neuromuscular conditions resulting in mobility impairment, gait deficit and balance deficit such as vertigo/giddiness, arthritis, Parkinson's disease and strokes can predispose older adults to falls. Sensory impairment including visual impairment and hearing loss also increases risk of falls, as do cognitive impairment and dementia. Polypharmacy and the use of certain medications have been associated with an increase in the risk of falls. Drugs that have been implicated include anti-hypertensives, hypnotics, tranquilisers/sedatives, anti-depressants and anti-arrhythmics.

##### c) Extrinsic factors

The living environment also poses risks. These include use of inappropriate footwear, inappropriate eyewear and environmental and home hazards. Personal factors and extrinsic factors can also interact to increase risks; and the level of risk of an environment may depend on the person. For example, an older adult with neuromuscular conditions and poor vision may have a higher risk of falls than an older adult without these intrinsic conditions living in the same housing environment. It is therefore important when assessing home and environmental hazards to consider the personal risk factors of the person who is living in the home or environment.

**Table 1: Common risk factors for falls**

Intrinsic risk factors	Extrinsic risk factors
<ul style="list-style-type: none"> <li>• Age<sup>7, 9, 10</sup></li> <li>• Female<sup>7, 9, 10</sup></li> <li>• Not married, including single and widowed<sup>10</sup></li> <li>• Living alone<sup>10</sup></li> <li>• Arthritis of knees<sup>9-12</sup></li> <li>• Stroke<sup>9</sup></li> <li>• Parkinson's disease<sup>9</sup></li> <li>• Hypertension<sup>7, 10</sup></li> <li>• Diabetes<sup>13</sup></li> <li>• Osteoporosis<sup>12</sup></li> <li>• Chronic conditions<sup>10</sup></li> <li>• Urinary incontinence<sup>11, 12</sup></li> <li>• Cognitive impairment<sup>11, 12, 14</sup></li> <li>• Depressive symptoms<sup>10, 11</sup></li> <li>• Poor vision<sup>7, 11, 12, 14</sup></li> <li>• Postural hypotension<sup>10, 12, 14</sup></li> <li>• Weak hand grip strength</li> <li>• Self-perceived poor health<sup>10</sup></li> <li>• Previous history of falls<sup>9-12</sup></li> <li>• Fear of falling<sup>10, 11</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Use of 4 or more prescribed drugs<sup>7, 11, 12</sup></li> <li>• Use of hypnotic, anti-depressants or tranquillisers<sup>11</sup> (please refer to table 2 for further details and other common group of drugs)</li> <li>• Use of walking aid<sup>10</sup></li> <li>• Mobility impairment<sup>7, 11, 12, 14</sup></li> <li>• Balance deficit<sup>11, 12, 14</sup></li> <li>• Gait deficit<sup>10, 11, 14</sup></li> <li>• Inappropriate footwear &amp; foot problems<sup>12</sup></li> <li>• Environmental &amp; home hazards<sup>7, 11, 12</sup></li> </ul>

**Table 2: Common groups of drugs that may increase risk of falls in older adults**

Common group of drugs that increases risk of falls
• <b>Anxiolytics/hypnotics</b> (benzodiazepines and others) <sup>15-19</sup>
• <b>Neuroleptics</b> (dopamine D2-receptor agonists and serotonin dopamine receptor antagonists) <sup>15-19</sup>
• <b>Antidepressants</b> (specifically tricyclic antidepressants and selective serotonin reuptake inhibitors, but may also include serotonin-norepinephrine reuptake inhibitors and monoamine oxidase inhibitors) <sup>15-19</sup>
• <b>Antihypertensives</b> (specifically diuretics, but may also include $\beta$ -adrenoceptor blockers, $\alpha$ -adrenoceptor blockers, centrally acting antihypertensives, calcium channel blockers, angiotensin converting enzyme inhibitors and angiotensin receptor blockers) <sup>18-20</sup>
• <b>Antiarrhythmics</b> (type 1a) <sup>18,20</sup>
• <b>Digoxin</b> <sup>14, 16</sup>
• <b>Analgesics</b> (including opioid and non-steroidal anti-inflammatory analgesics) <sup>15, 18, 19</sup>
• <b>Antihistamines</b> (especially first-generation with highly sedating and anticholinergic effects) <sup>17, 18</sup>
• <b>Hypoglycaemics</b> (especially long-acting sulfonylureas with prolonged hypoglycaemic effects) <sup>13, 14</sup>
• <b>Skeletal muscle relaxants</b> (anticholinergic side effects may increase risk for falls) <sup>17</sup>
• <b>Anticonvulsants</b> <sup>17</sup>
• <b>Nitrates and other vasodilators</b> <sup>18</sup>
• <b><math>\beta</math>-adrenoceptor blocking eye drops</b> <sup>18</sup>
• <b>Urinary antispasmodics</b> <sup>18</sup>
• <b>Antivertigo drugs</b> <sup>18</sup>

## 2. Screening for falls

Studies have shown that risk factors for falls can be used to identify older adults who are at risk of falling. A history of falls is a strong predictor of future falls and those who have fallen are likely to have risk factors for falls. Gait and balance problems may be present in both older adult fallers and non-fallers and predict future falls in both groups.

While there are studies on screening tools to assess the risk of falling among the older adults in community settings, no specific studies could be found on the effectiveness of fall risk factor assessment in general practice. Recommendations on fall risk assessment in the primary care setting were thus extrapolated from the available evidence.

There is no evidence to support population based screening for falls in the older adults, in general.

### 2.1 Risk Factors for Falls

Multiple fall risk factors have been identified as predictors of falls in older adults living in the community but a few have been shown to be consistent in two systemic reviews.<sup>12</sup> These are fall history, gait and balance deficit, mobility impairment, visual impairment, urinary incontinence, cognitive impairment and fear of falling. The risk for falling increases with the number of risk factors; 8% for those with zero risk factors, 19% with one risk factor, 32 % for those with two risk factors and 60% with three risk factors.<sup>21</sup>

### 2.2 Identifying the At-risk Group

Case identification using some of the identified fall risk factors has been used in many guidelines to select cases for further assessment. The American Geriatrics Society (AGS) screening algorithm begins with enquiring for history of previous falls.<sup>22</sup> A history of previous falls has been shown to be an independent predictor of future falls with a sensitivity of 93% and specificity of 21% for predicting single fall. It is also a predictor for recurrent falls with a sensitivity of 77% and specificity of 52%.<sup>23</sup> The prevalence of fall risk factors is higher in those who have had previous falls.<sup>21</sup>

Those without a self-reported history of falls have an annual fall incidence of 27% to 45%.<sup>24</sup> Gait and balance problems are common in the older adults and they are independent predictors of future falls in both previous fallers and non-fallers.<sup>9, 24, 25</sup>

**GPP** All older adults (65 years old and older) during a healthcare encounter should be asked for history of falls, and gait and balance problems. **GPP**

**D** Older adults who have fallen more than once in 6 months or with gait and balance deficits should be offered a comprehensive falls assessment.

**Grade D, Level 3**

## 2.3 Administering Assessments

The Australian Commission for Safety and Quality in Healthcare (ACSQHC) guidelines<sup>12</sup> recommend either general practitioners or other healthcare professionals to utilise multi-factorial assessment tools. General practitioners have the most contact with the population at risk. They are thus well suited to identify older adults living in the community who are at risk for falls.

However, the rates of detection and documentation of assessment needs to be improved. In a study of 372 vulnerable older adults using medical record review and telephone interview, general practitioners appear to under-detect falls.<sup>26</sup> Only 14% (57 of 372 subjects) had documentation of falls, whereas 28% (68 of 245 subjects) reported falls during the interview.

Postal screening surveys followed by a telephone geriatric assessment by a physician assistant may be useful for identifying fall events, but do not translate into a reduction in recurrent falls.<sup>27</sup>

## 2.4 Recommended Falls Risk Assessment

The ACSQHC<sup>12</sup> and AGS/BGS guidelines<sup>22</sup> recommend a wide range of falls risk factors for assessment, which may not be feasible or practical in a general practice consultation.<sup>22</sup> No strength of recommendation is given in these guidelines.

The NICE guidelines<sup>11</sup> report that it is unclear which falls risk assessment is the most predictive or useful. It suggests that assessment tools are more suitable for multidisciplinary team assessments.

In a systematic review for the US Preventive Services Taskforce,<sup>28</sup> multi-factorial assessment and intervention in the primary care setting was found to produce a non-significant decrease in fall risk in a pooled analysis of 19 studies (7,099 subjects). The assessments were heterogeneous. Most included medication use, visual acuity, home environment, and gait and balance.

In another systematic review on multi-factorial assessment and intervention in emergency care, primary care and community settings,<sup>23</sup> there was limited evidence that multi-factorial fall prevention programmes could effectively reduce the number of fallers or fall related injuries. The data was insufficient to assess fall and injury rates. The assessments were also heterogeneous, the most common being gait and balance, drug review and assessment of home environment.

In a prospective cohort study of 311 subjects on the risk factors for recurrent falls,<sup>29</sup> the best predictors were depression (using SCL90 scoring), hand grip strength (using a dynamometer), history of falls and postural sway (originally using force plates). Apart from fall history, these are not feasible in a general practice setting.

Refer to **Annex A** for a suggested algorithm for falls risk assessment.

## **2.5 Falls Risk Assessment Tools**

The falls risk assessment tools can be classified as either Functional Mobility Assessment (FMA) tools or Multi-factorial Assessment (MFA) tools.

For a tool to have a high predictive value it has to demonstrate sensitivity measures above 80% and specificity above 75%.<sup>30</sup>

### 2.5.1 Functional Mobility Assessment (FMA) Tools

FMA tools involve assessment of functional domains of postural stability that look at strength, balance, gait, and reaction time.

These tools can consist of a single measure or a scale comprising multiple gait and balance assessments with a weighted scoring. Some examples of commonly used tools during fall screening include the Functional Reach, Time Up and Go (TUG) test, Single Leg Stand, 5 times chairstand, Berg Balance Scale and the Tinetti Performance Oriented Mobility Assessment.<sup>31-33</sup>

In one large prospective study comparing TUG, One Leg Stand, Tinetti Balance and Functional Reach in older adults living in the community, TUG had the largest area under the receiver operating characteristic (ROC) curve to predict falling (0.61). A substantial proportion of the subjects was unable to perform the one leg stand and functional reach implying a floor effect in older adults with lower function.<sup>34</sup>

There is a wide variation in physical function amongst older adults living in the community and this has been shown to affect the discriminative performance of these tools.<sup>35</sup> Three systemic reviews on TUG found the test to be less discriminative in persons with high or low fall risk, better in lower functioning populations and better at predicting past falls than future falls.<sup>35, 36, 37</sup>

Due to the multi-factorial nature of falls no single functional mobility tool seems able to predict falls accurately.<sup>31</sup>

Here we recommend that FMA be used as a functional gait and balance assessment as part of a more comprehensive assessment rather than as a single tool for assessing fall risk.

### 2.5.2 Multi-factorial Assessment (MFA) Tools

MFA tools usually include a few well known risk factors for falls and may include a functional component. These tools are usually in the form of a checklist and have a weighted scoring system which gives the risk scores. MFAs are sometimes used to help identify risk factors that are modifiable through interventions. An example of an MFA is the Fall Risk Assessment Tool (FRAT) developed to help health or social care workers identify older people living in the community who are at risk of falls. The tool consists of four questions and one performance test; the presence of 3 or more risk factors had a positive predictive value for a fall in the next 6 months of 0.57 (95 % CI 0.43-0.69) and a specificity of > 80%.<sup>38</sup>

## 3. Falls Prevention Interventions

Interventions to prevent falls in older adults living in the community can be implemented as a single intervention or as a component of multiple or multi-factorial interventions.

### 3.1 Single Interventions

Single interventions consist of only one major category of intervention.

#### 3.1.1 Exercise interventions

Exercise is effective as a single modal intervention in preventing falls in older adults living in the community.<sup>1,2,39-42</sup> The effectiveness of exercise in reducing the risk and rate of falls is increased when exercise is combined with a multi-factorial fall risk assessment and management programme.<sup>39,41</sup>

Exercises consisting of two or more aspects of strength, balance, flexibility or endurance can help reduce the rate of falls in older adults living in the community.<sup>1,2,40</sup> Specifically, exercises which include a balance component (including taiqi) have been shown to be beneficial in reducing the risk and rate of falls in older adults, especially in those identified as being at high risk of falls.<sup>1,2</sup> Specific exercises such as taiqi, and balance and coordination training have also been shown to help in reducing falls rate.<sup>43-47</sup>

It was noted that older adults with higher compliance (at least 75%)<sup>42</sup> with their exercise programme will also have further reduction in the risk of falling.<sup>42,48</sup> These exercises can be achieved via a home-based (individually prescribed) exercise programme and/or via a group-based programme in a supervised setting.<sup>1,2,48-50</sup>

The recommended exercise structure\* for prevention of falls in older adults living in the community is as follows:

**A** Exercise programmes for falls prevention should consist of at least a twice-weekly programme for more than 25 weeks, with each session lasting for 60 minutes.<sup>1,2</sup>

Grade A, Level 1+

**A** Exercise intensity can be pegged at a moderate level. These exercises should be progressive and individualised to maximise the effectiveness of the programme.

**Grade A, Level 1+**

Note: Moderate intensity exercise is defined as the intensity at which a person experiences an increase in heart rate where he or she is somewhat breathless. Measurements that can be used to gauge moderate level intensity of exercise include:

- Heart rate measurement: 70-80% of Maximum Heart Rate (where  $HR_{max} = 220 - \text{current age}$ )
- Rate of self-perceived exertion (RPE): Using RPE at a level where the person feels that it is 'somewhat hard to breathe' or 5-6 on a scale of 10
- Talk test: Where a person feels somewhat breathless when exercising but is still able to talk
- Metabolic Equivalent of Task: 3-6 METs

**A** Exercises should consist of a mix of balance and coordination training, lower limb strengthening (such as strengthening exercise for hip muscles, knee extensors and ankle plantar flexors), endurance and flexibility training.

**Grade A, Level 1+**

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*\* It is noted that there is variance in exercise intervention duration from about 6 weeks to a year with a median of about 12 weeks for these studies. However some of these studies might not have monitored the participants' compliance with home exercise programmes. Note that the physical activity recommendation (for those aged 50 years and above) under <http://www.hpb.gov.sg/HOPPortal/health-article/10368> consists of aerobic activity (150 minutes of moderate intensity), strength training (twice or more per week) and balance training.*

### 3.1.2 Home Modification

Home assessment and modification are effective in reducing the rate of falls in older adults.<sup>51-57</sup> In particular, home assessment and modification are effective in reducing the rate of falls in older adults at high risk of falls,<sup>53, 57</sup> with a history of falls,<sup>55, 56</sup> and those with visual impairment.<sup>51</sup> Home modification interventions have not been shown to be effective in reducing the rate of falls in older adults in studies where a research nurse<sup>58</sup> or a trained assessor<sup>59</sup> conducted the home visit. Home modification interventions are more effective in reducing the rate of falls when they are delivered by occupational therapists compared to trained assessors. This may be due to occupational therapists having an enhanced knowledge of the effects of the environment on function and greater adherence to recommendations made by occupational therapists.<sup>57</sup>

**B** Older adults assessed to have a high risk of falls, history of falls or those with visual impairment should be referred to occupational therapist for home assessment and modification intervention.

**Grade B, Level 1+**

### 3.1.3 Footwear

There is limited evidence for footwear as an effective single intervention in reducing falls. There are recommendations to wear low heeled,<sup>60-62</sup> slip resistant shoes<sup>60, 61</sup> with a large contact area<sup>62</sup> but these are inferred from studies that have weak methodology and limitations in generalisability and applicability.

**D** Older adults should be advised to wear well-fitting shoes with low heeled, slip resistant soles and a large contact area to reduce falls.

**Grade D, Level 4**

### 3.1.4 Medication review and modification

Interventions involving active review and modification of medications associated with increased risks of falls may be provided as a single intervention or part of a multi-factorial intervention.<sup>18, 63, 64</sup> Specifically, interventions provided by physicians in collaboration with pharmacists in the primary care setting have been shown to reduce the risk of falls among older adults living in the community.<sup>65</sup> The list of medications associated with falls has been summarised in Table 2.

**B** Medication review and modification to optimise medication use should be provided by the primary care physician in collaboration with a pharmacist (if available), clinical specialist(s) (in cases where specific medications are prescribed by them), the individual older adult and his/her primary caregiver where applicable, for older adults who are taking medications that can increase their risk for falls. This can be performed either as a single intervention or part of a multi-factorial intervention.

**Grade B, Level 1+**

A randomised controlled trial of an intervention to actively withdraw benzodiazepines and antipsychotics reduced the rate of falls among older adults living in the community.<sup>66</sup> This intervention should be made with appropriate dose tapering, close monitoring of outcomes and when necessary, input from clinical specialists, such as psychiatrists.

**B** Psychotropic medications (benzodiazepines and antipsychotics) should be discontinued in older adults (if possible) to prevent falls. This should be done with appropriate tapering of dose, close monitoring of outcomes and input from clinical specialists if necessary.

**Grade B, Level 1+**

### 3.1.5 Vitamin D supplementation

Vitamin D deficiency is prevalent in Singapore.<sup>67</sup> There is generally suboptimal appreciation by both physicians and patients of the importance of vitamin D and calcium for maintenance of bone health as reflected in the low number of patients who reported regularly taking these supplements.<sup>68</sup>

Performance speed and proximal muscle strength were markedly improved when 25-hydroxyvitamin D levels increased from 4 to 16 ng per millilitre (10 to 40 nmol per litre) and continued to improve as the levels increased to more than 40 ng per millilitre (100 nmol per litre).<sup>69</sup>

Vitamin D therapy (200–1000 IU) resulted in fewer falls than calcium therapy or use of a placebo. The following subgroups had significantly fewer falls:<sup>70-72</sup>

- a. living in the community (aged < 80 years),
- b. adjunctive calcium supplementation,
- c. no history of fractures or falls,
- d. duration longer than 6 months, cholecalciferol, and dose of 800 IU or greater.

Nursing home residents receiving 800 IU of vitamin D2 per day plus calcium had a 72% reduction in the risk of falls as compared with the placebo group.<sup>73</sup> Vitamin D supplementation of  $\geq 800$  IU daily is favourable in the prevention of hip fracture and any non-vertebral fracture in persons 65 years of age or older.<sup>74</sup>

Vitamin D (ergocalciferol) supplementation of 1200 IU a day decreases falls and hip fractures in vascular parkinsonism but not in Parkinson's disease. Vitamin D (ergocalciferol) supplementation of 1000 IU a day decreases falls in women after stroke with hemiplegia.<sup>75, 76</sup> However, among older women living in the community, annual oral administration of high-dose cholecalciferol (500,000 IU per year) resulted in an increased risk of falls and fractures.<sup>4</sup>

The general approach to supplementation is to give vitamin D3 at 3000 units a day or vitamin D2 at 50,000 units a week for 2 months for every 12.5 ng per litre improvement in serum vitamin D levels.<sup>77</sup> The Vitamin D3 loading dose required to reach the serum 25-OH vitamin D3 target level of 75 nmol per litre can be calculated as follows:

$$\text{Dose (IU)} = 40 \times (75 - \text{serum 25-OH vitamin D3}) \times \text{body weight.}^{77}$$

*Note: 2.5 nmol/L = 1 ng/ml of 25 OH vitamin D*

Based on this formula, assuming an average body weight of 60kg, the general approach to repletion is to give vitamin D3 at 2000 units a day or vitamin D2 at 50,000 units a week for 1 month for every 10ng/ml improvement in serum 25 OH vitamin D levels.

**D** It may be helpful to give vitamin D supplementation to older adults if their vitamin D level is less than 20 ng per millilitre (50 nmol per litre), if higher levels cannot be achieved via sunlight or dietary supplementation.<sup>3</sup> Older adults with significant renal impairment will benefit from treatment with analogues of vitamin D (alfacalcidol or calcitriol).

**Grade D, Level 4**

**B** Avoid the use of high dose cholecalciferol (500,000 IU per year).<sup>4</sup>

**Grade B, Level 1+**

### 3.1.6 Improving Vision

First eye cataract surgery can reduce the risks of falls and the rate of falls in older adults.<sup>78-82</sup>

Except for first eye cataract surgery,<sup>78</sup> there is no concrete evidence that correcting vision alone through referral to appropriate professionals (including second eye cataract surgery) reduces the risk of falls.<sup>59, 83</sup> However, vision assessment and referral can be an element for successful multi-factorial falls prevention intervention and improve quality of life.<sup>59, 83, 84</sup>

**GPP** Older adults who have impaired vision should be referred for further evaluation of the cause of impairment.

**GPP**

**B** Persons with cataract as the main cause of vision impairment should be referred for cataract surgery (especially for first eye).

**Grade B, Level 1+**

### 3.1.7 Cardiac Pacemaker Insertion

Cardiac pacing can reduce the number of falls in people with cardioinhibitory carotid sinus hypersensitivity.<sup>63</sup>

**B** Older adults with suspected cardiogenic falls should be referred to a cardiologist for further evaluation. Cardiac pacing is recommended for patients with cardioinhibitory carotid sinus hypersensitivity and a history of falls.

**Grade B, Level 1+**

### 3.1.8 Education Intervention

There is no concrete evidence that education intervention alone reduces the rate or risk of falls in older adults living in the community.<sup>63, 85</sup> However, providing basic information about the benefits of falls prevention can potentially help older adults make informed choices about engaging in falls prevention interventions and potentially improve adherence to these interventions.

**GPP** Provide basic information on falls and educate older adults on the benefits of falls prevention strategies in preventing falls and maintaining independence.

**GPP**

### **3.2 Multiple Interventions**

Multiple interventions consist of a fixed combination of two or more major categories of intervention. Falls prevention programmes consisting of multiple interventions including exercise, can reduce the number of falls and risk of falls in older adults living in the community.<sup>63</sup>

**B** Older adults at risk of falls should be considered for referral to falls prevention programmes consisting of exercise and other interventions, if such programmes are available and accessible.

**Grade B, Level 1+**

### **3.3 Multi-factorial Interventions**

Multi-factorial interventions consist of more than one major category of intervention. These interventions are tailored to the individual patient following the assessment of his/her risk of falling. There is conflicting evidence on the effectiveness of multi-factorial interventions on the prevention of falls among older adults living in the community.<sup>23, 63, 86-88</sup> However, individually targeted multi-factorial interventions have been shown to reduce the number of falls in the subgroup of patients who are at high risk of falls.<sup>63</sup> Active interventions are more effective than provision of education alone.<sup>63</sup>

**B** Older adults assessed to be at high risk of falls should receive interventions targeted at the individually identified risk factors.

**Grade B, Level 1+**

## 4. Cost-Effectiveness of Falls Prevention

### 4.1 Impact of Singapore's Aging Population

The burden of falls in Singapore is likely to rise in time. This is because the incidence of falls increase very sharply with age, and Singapore faces the challenges of a rapidly aging population. According to data from the Department of Statistics, Singapore,<sup>89</sup> in 2011, 14.8% of the Singapore resident population were 60 years or older. By 2030<sup>90</sup> it is estimated that one in five Singaporeans will be above the age of 65.

### 4.2 Consequences and Cost of Falls - Injury and Fractures

The main consequences of a fall include head injury, fractures and soft-tissue injury to the body. Head injury resulting from falls is an important source of morbidity in older adults including hospitalisation. Fractures are also a major cause of morbidity and mortality. Common fracture sites include Colles' fracture of the wrist, fractures of upper and lower limbs, and hip fractures. The morbidity and mortality burden associated with hip fractures in particular is very high. Wrist fractures are more common than hip fractures between ages 65 and 75, whereas hip fractures predominate in ages after that.

A retrospective study<sup>91</sup> was done in year 2002 on 274 older adult patients aged 60 years or older. They were patients admitted to public hospitals for hip fractures over a 3-year period (year 1991 to 1993). 58% were intertrochanteric fractures and 42% femoral neck fractures. 66% of the patients had significant medical co-morbidities. 264 (95%) patients were operated upon. The mean total hospitalisation period was 17 days. 76% of these patients were living in the community before the fracture while 22% were admitted from nursing homes. After surgery, 63% returned to their homes while 25% needed nursing home care. The index admission mortality rate was 5.7% and mortality was 26% at 1 year. Of those alive at one year, 28% were walking without aids, 39% were walking with aids, 24% wheelchair bound and 9% were bedridden. The average hospital bill was S\$7,367, and the average subsidy was S\$6,335. 91% of the cases were warded in subsidised B2 and C class wards.

Another study of patients with surgically treated osteoporotic hip fractures found that the mean length of hospital stay was 16 days, and the mean hospitalisation cost incurred was S\$10,515.<sup>92</sup>

In Singapore, about 2,300 adults aged 50 years and above were admitted for hip fracture in 2012, and this number is expected to rise to 5,000 by 2025.<sup>93</sup>

### **4.3 Psychological Trauma**

The psychological fear of falling in the older adults who survived a fall is real and may lead to a self-imposed restriction of mobility. The incidence of fear of falling is estimated to be around 40% to 70% in fallers.<sup>94</sup> This may potentially perpetuate the cycle where the fear of falling leads to self-imposed reduced mobility which then in turn leads to further functional decline resulting in higher risk of falls.

Repeated fallers are also at higher risk of being institutionalised.<sup>95</sup>

### **4.4 Cost Effectiveness of Interventions**

Interventions can be cost-effective; and international studies indicate that multi-factorial falls prevention programmes especially may be cost effective.<sup>54, 96-99</sup> The true extent of benefits is not clear. Furthermore, there is little local data; hence a proper cost effectiveness analysis needs to be performed in conjunction with trials of falls intervention programmes in Singapore.

## 5. Clinical Quality Improvement

In view of the high falls incidence and the morbidity and mortality risks imposed by such falls, it is important to monitor falls rates and complications from falls amongst the older adults. Proposed national indicators include the following:

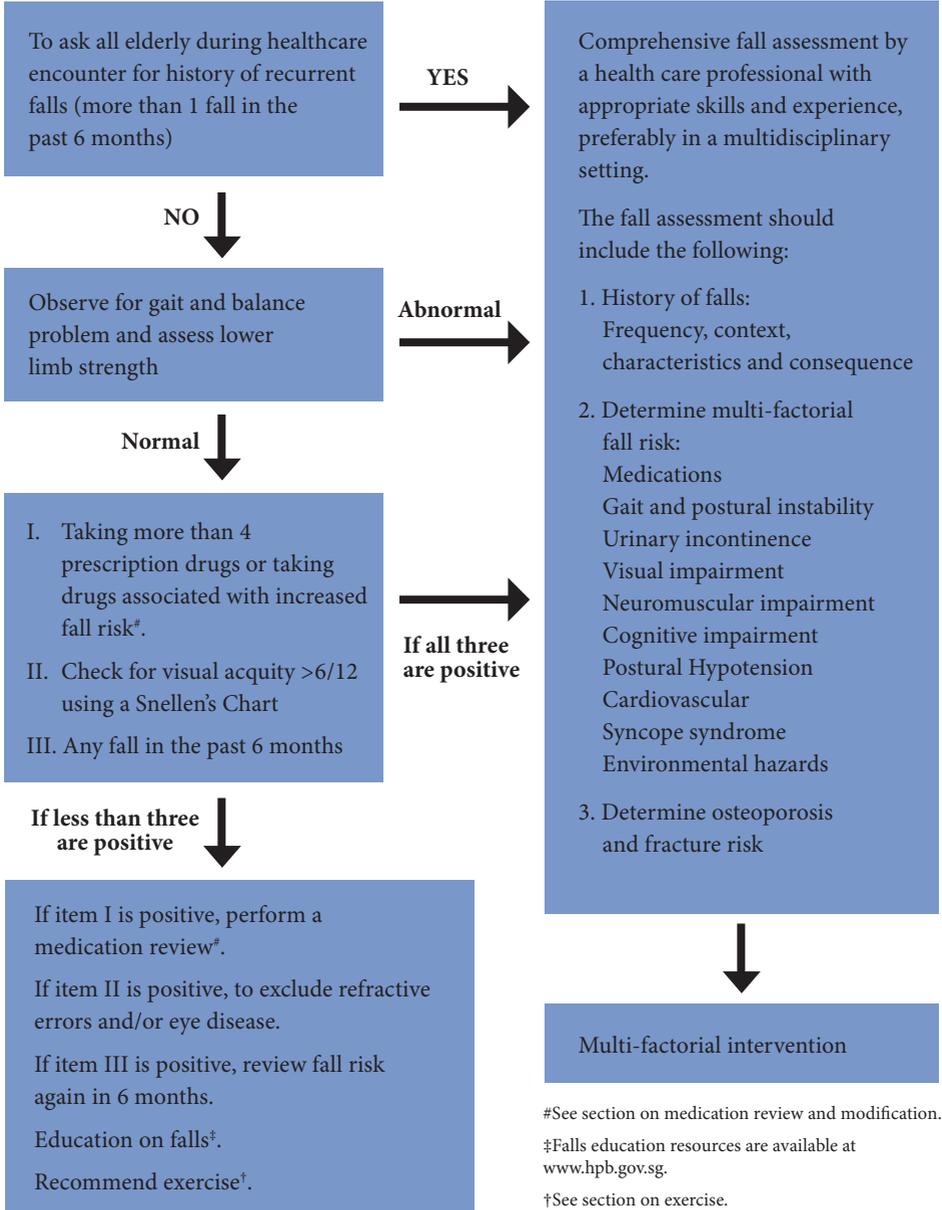
- Age-adjusted incidence rates of falls (regardless of consequences) among those aged 65 years and above.
- Age-adjusted admission rate for injuries resulting from falls among those aged 65 years and above.

Data for these three indicators can be obtained from:

- Representative cross-sectional surveys of the older adults
- Hospital discharge data
- Hospital emergency department data

# Annex A

## Algorithm for Assessing Fall Risk in Older Adults Living in the Community



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## Self-assessment (MCQs)

After reading the Clinical Practice Guidelines, you can claim one CME point under Category 3A (Self-Study) of the SMC Online CME System. Alternatively, you can claim one CME point under Category 3B (Distance Learning – Verifiable Self Assessment) if you answer at least 60% of the following MCQs correctly. You can submit your answers through the SMJ website at this link: [smjcme.sma.org.sg](http://smjcme.sma.org.sg) (the link will only be available once the May 2015 issue of SMJ becomes available). The answers will be published in the SMJ July 2015 issue and at the MOH/HPB webpage for these guidelines after the period for submitting the answers is over.

Instruction: Choose the right answer(s). There may be more than one answer for some questions.

### 1. Regarding incidence of falls and risk factors for falls

- A. Male older adults are at higher risk of falls compared to female older adults.
- B. A significant predictor of future fall risk is a history of a fall in the past one year.
- C. Neuromuscular conditions resulting in mobility impairment, gait deficit and balance deficit together with polypharmacy pre-disposes older adults to falls.
- D. As the number of risk factors increase, the risk for falls increases.

### 2. Regarding screening for falls

- A. All older adults should be asked for a past history of falls.
- B. General practitioners or other healthcare professionals can utilise multi-factorial assessment tools to identify older adults who are at risk of falls.
- C. If gait and balance problems are observed, a comprehensive fall assessment is recommended.
- D. Functional Mobility Assessment tools look at strength, balance, gait and reaction time.

### **3. Regarding falls prevention interventions**

- A. Exercises consisting of two or more aspects of strength, balance, flexibility or endurance is not effective in reducing the rate of falls in older adults.
- B. Home assessment and modification interventions conducted by occupational therapists are effective in reducing the rate of falls especially for those who have a high risk of falls, history of falls or those with visual impairments.
- C. Vitamin D deficiency is uncommon in Singapore due to the sunny weather.
- D. First eye cataract surgery can reduce the risks of falls and the rate of falls in older adults.

### **4. Regarding falls prevention interventions**

- A. Providing basic information about the benefits of falls prevention can help older adults make informed choices about engaging in falls prevention interventions and improve adherence to these interventions.
- B. Multi-factorial interventions that target specific risk factors have been shown to be effective in preventing falls.
- C. Older adults with high risk of falls should receive interventions targeted at the individually identified risk factors.
- D. Active review and modification of medications associated with increased risks of falls is recommended as a form of falls prevention intervention.

### **5. Regarding consequences and cost of falls**

- A. Besides the physiological trauma of a fall, psychological fear of falling is real and may lead to self-imposed mobility restriction.
- B. Head injury and fractures are major causes of morbidity and mortality following a fall.
- C. The most common fracture sites from falls include Colles' fracture of the wrist, fractures of upper and lower limbs and hip fractures.
- D. Hip fractures predominate in older adults between the ages of 65 and 75.

## Answers

1. B, C, D

2. A, B, C, D

3. B, D

4. A, B, C, D

5. A, B, C

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