

Integrated care for older people (ICOPE)  
Guidelines on community-level interventions  
to manage declines in intrinsic capacity

## Evidence profile: mobility loss

Scoping question:

Does physical exercise training  
(progressive resistance training or  
multimodal exercise) produce any benefit  
or harm for older people with limitations in  
activities of daily living (ADLs)?

**The full ICOPE guidelines and complete  
set of evidence profiles are available at  
[who.int/ageing/publications/guidelines-icope](http://who.int/ageing/publications/guidelines-icope)**

Painting: "Wet in Wet" by Gusta van der Meer. At 75 years of age, Gusta has an artistic style that is fresh, distinctive and vibrant. A long-time lover of art, she finds that dementia is no barrier to her artistic expression. Appreciated not just for her art but also for the support and encouragement she gives to other artists with dementia, Gusta participates in a weekly art class. Copyright by Gusta van der Meer. All rights reserved

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## Background

A recent meta-analysis of 54 studies reported that the prevalence of limitations in activities of daily living (ADL) was 39% among older people over 65 years of age, three times the proportion in working age groups (1). With increasing age, the ability of older people to perform basic activities declines. The rate of decline is not homogeneous, however, and is largely determined by the environments people inhabit. Population studies have shown that up to 20% of older people improve their ability with exercise interventions (2), and many frequently transit between high and low capacity within the same age group (3). This dynamic nature provides room for restoration and maintenance of optimal physical capacity even in the oldest age group.

A growing body of evidence suggests strong associations between a reduced ability to perform basic activities and adverse outcomes, such as premature mortality (4), institutionalization (5, 6), risk of falls (7), depression (8), cognitive impairment (9) and decreased quality of life (10). Intervention trials of multimodal physical exercise training targeting modifiable risk factors such as strength

and balance have shown significant benefits for older people with reduced physical capacity, even in the very old and severely impaired (11). Simple physical exercise, such as walking, has shown significant reductions in the levels of need for assistance in daily activities (12). There is also empirical support from earlier reviews for the benefit of exercise on behaviour, cognition, communication and functioning in older people with cognitive impairments.

In this context, understanding the effect of physical exercise on older people with limitations in physical and cognitive function is extremely important. To assess its benefits, we reviewed the evidence of the effects of physical exercise on muscle strength, balance, gait speed, chair stand, timed up and go, ADL and physical functioning measured by the Short Physical Performance Battery (13). Although evidence from developed countries has shown potential benefit of physical-activity programmes for older people, it is still unclear whether such evidence and recommendations could be relevant for older people in low-resource health care settings, where the majority of older people in the world reside.

## Part 1: Evidence review

### Scoping question in PICO format (population, intervention, comparison, outcome)

#### Population

- Noninstitutionalized older people with limitations in activities of daily living (ADLs)

#### Interventions

- Progressive resistance exercise (PRE)
- Multimodal exercise (combining two or more types of exercise: PRE or strength, balance, stretching, and endurance or aerobic exercise)

#### Comparison

- No exercise
- Attention-control
- Usual care or waiting list

#### Outcomes

- *Critical*: Muscle strength, balance, chair stand, timed up and go, physical functioning, ADLs, cognition
- *Important*: Gait speed

## Search strategy

The following electronic databases were used to identify studies for this review: Ovid MEDLINE, 1966 to April 2011; EMBASE, 1960 to April 2011; and the Cochrane Database of Systematic Reviews and Cochrane Central Register of Controlled Trials (CENTRAL), till April 2011. A recent search was conducted in October 2015 to update the sources of literature. Details of the search strategy are in Annex 1.

## List of systematic reviews identified by the search process

### Included in GRADE<sup>1</sup> tables or footnotes

#### *Older adults with limitations in physical function*

— Cadore EL, Rodríguez-Mañas L, Sinclair A, Izquierdo M. Effects of different exercise interventions on risk of falls, gait ability, and balance in physically frail older adults: a systematic review. *Rejuvenation Res.* 2013;16:105–14. doi:10.1089/rej.2012.1397.

— Chou C-H, Hwang C-L, Wu Y-T. Effect of exercise on physical function, daily living activities, and quality of life in the frail older adults: a meta-analysis. *Arch Phys Med Rehabil.* 2012;93:237–44. doi:10.1016/j.apmr.2011.08.042.

— Daniels R, van Rossum E, de Witte L, Kempen GJIM, van den Heuvel W. Interventions to prevent disability in frail community-dwelling elderly: a systematic review. *BMC Health Serv Res.* 2008;8:278. doi:10.1186/1472-6963-8-278.

— de Vries N, van Ravensberg C, Hobbelen J, Olde Rikkert MGM, Staal JB, Nijhuis-van der Sanden MWG. Effects of physical exercise therapy on mobility, physical functioning, physical activity and quality of life in community-dwelling older adults with impaired mobility, physical disability and/or multi-morbidity: a meta-analysis. *Ageing Res Rev.* 2012;11(1):136–49. doi:10.1016/j.arr.2011.11.002.

— Giné-Garriga M, Roqué-Fíguls M, Coll-Planas L, Sitjà-Rabert M, Salvà A. Physical exercise interventions for improving performance-based measures of physical function in community-dwelling, frail older adults: a systematic review and meta-analysis. *Arch Phys Med Rehabil.* 2014;95:753–69.e3. doi:10.1016/j.apmr.2013.11.007.

— Gillespie LD, Robertson MC, Gillespie WJ, Sherrington C, Gates S, Clemson LM, Lamb SE. Interventions for preventing falls in older people living in the community. *Cochrane Database Syst Rev.* 2012;(9):CD007146. doi:10.1002/14651858.CD007146.pub3.

— Howe T, Rochester L, Neil F, Skelton D, Ballinger C. Exercise for improving balance in older people. *Cochrane Database Syst Rev.* 2011;(11):CD004963. doi:10.1002/14651858.CD004963.pub3.

— Liu C, Latham N. Progressive resistance strength training for improving physical function in older adults. *Cochrane*

<sup>1</sup> GRADE: Grading of Recommendations Assessment, Development and Evaluation. More information: <http://gradeworkinggroup.org>

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*Database Syst Rev.* 2009;(3):CD002759.  
doi:10.1002/14651858.CD002759.pub2.

— van Abbema R, De Greef M, Crajé C, Krijnen W, Hobbelen H, Van Der Schans C. What type or combination of exercise can improve preferred gait speed in older adults? A meta-analysis. *BMC Geriatr.* 2015;15:72. doi:10.1186/s12877-015-0061-9.

#### *Older adults with limitations in cognitive function*

— Burton E, Cavalheri V, Adams R, et al. Effectiveness of exercise programs to reduce falls in older people with dementia living in the

community: a systematic review and meta-analysis. *Clin Interv Aging.* 2015;10:421–34. doi:10.2147/CIA.S71691.

— Forbes D, Forbes SC, Blake CM, Thiessen EJ, Forbes S. Exercise programs for people with dementia. *Cochrane Database Syst Rev.* 2015;(4):CD006489. doi:10.1002/14651858.CD006489.pub4.

— Pitkälä K, Savikko N, Poysti M, Strandberg T, Laakkonen M-L. Efficacy of physical exercise intervention on mobility and physical functioning in older people with dementia: a systematic review. *Exp Gerontol.* 2013;48(1):85-93. doi:10.1016/j.exger.2012.08.008.

PICO Table

	Intervention/ comparison	Outcomes	Systematic reviews used for GRADE	Explanation
Older people with limitations in physical function	Multimodal exercise, progressive resistance exercise, or t'ai chi vs no exercise, attention control, or waiting list	<ul style="list-style-type: none"> <li>• Muscle strength</li> <li>• Balance</li> <li>• Gait speed</li> <li>• Chair stand</li> <li>• Timed up and go</li> <li>• Overall physical functioning</li> <li>• Activities of daily living (ADL)</li> <li>• Falls</li> </ul>	<p>Cadore EL, Rodríguez-Mañas L, Sinclair A, Izquierdo M. Effects of different exercise interventions on risk of falls, gait ability, and balance in physically frail older adults: a systematic review. <i>Rejuvenation Res.</i> 2013;16:105–14. doi:10.1089/rej.2012.1397.</p> <p>Chou C-H, Hwang C-L, Wu Y-T. Effect of exercise on physical function, daily living activities, and quality of life in the frail older adults: a meta-analysis. <i>Arch Phys Med Rehabil.</i> 2012;93:237–44. doi:10.1016/j.apmr.2011.08.042.</p> <p>Daniels R, van Rossum E, de Witte L, Kempen GJ, van den Heuvel W. Interventions to prevent disability in frail community-dwelling elderly: a systematic review. <i>BMC Health Serv Res.</i> 2008;8:278. doi:10.1186/1472-6963-8-278.</p> <p>de Vries N, van Ravensberg C, Hobbelen J, Olde Rikkert MGM, Staal JB, Nijhuis-van der Sanden MWG. Effects of physical exercise therapy on mobility, physical functioning, physical activity and quality of life in community-dwelling older adults with impaired mobility, physical disability and/or multimorbidity: a meta-analysis. <i>Ageing Res Rev.</i> 2012;11(1):136–49. doi:10.1016/j.arr.2011.11.002.</p> <p>Giné-Garriga M, Roqué-Fíguls M, Coll-Planas L,</p>	<p>Systematic review relevant to the area</p> <p>(continued next page)</p>

			<p>Sitjà-Rabert M, Salvà A. Physical exercise interventions for improving performance-based measures of physical function in community-dwelling, frail older adults: a systematic review and meta-analysis. <i>Arch Phys Med Rehabil.</i> 2014;95:753–69.e3. doi:10.1016/j.apmr.2013.11.007.</p> <p>Howe T, Rochester L, Neil F, Skelton D, Ballinger C. Exercise for improving balance in older people. <i>Cochrane Database Syst Rev.</i> 2011;(11):CD004963. doi:10.1002/14651858.CD004963.pub3.</p> <p>van Abbema R, De Greef M, Crajé C, Krijnen W, Hobbelen H, Van Der Schans C. What type or combination of exercise can improve preferred gait speed in older adults? A meta-analysis. <i>BMC Geriatr.</i> 2015;15:72. doi:10.1186/s12877-015-0061-9.</p>	
	Progressive resistance exercise vs no exercise or attention control	<ul style="list-style-type: none"> <li>• Muscle strength</li> <li>• Balance</li> <li>• Gait speed</li> <li>• Chair stand</li> <li>• Timed up and go</li> <li>• Overall physical functioning</li> <li>• Activities of daily living (ADL)</li> <li>• Falls</li> </ul>	<p>Liu C, Latham N. Progressive resistance strength training for improving physical function in older adults. <i>Cochrane Database Syst Rev.</i> 2009;(3):CD002759. doi:10.1002/14651858.CD002759.pub2.</p>	Systematic review relevant to the area



## Narrative description of the studies that went into analysis

### Systematic reviews on physical exercise for older people without dementia

Cadore et al. conducted a systematic review of the effects of different exercise interventions on risk of falls, gait ability and balance in physically frail older adults. Studies published from 1990 to 2012 were searched in the Scientific Electronic Library Online (SciELO), Science Citation Index, MEDLINE, Scopus, SPORTDiscus, and ScienceDirect databases. Twenty studies were included in their review. Seven out of the 20 studies (1420 participants), which recruited frail older people or those with a history of falling or a risk of falls, were added to the scope of this review conducted for the guidelines process. The average ages ranged from 72 to 83 years. The duration of exercise ranged from 10 weeks to 1 year. Six trials applied multimodal exercise and one applied progressive resistance exercise. The lead authors of these seven studies were from Australia, Brazil, Germany, Japan and USA.

Chou et al. conducted a meta-analysis to evaluate the effect of exercise on physical function, activities of daily living, and quality of life in the frail older adults. Studies published between 2001 and 2010 were searched in PubMed, MEDLINE, EMBASE, Chinese Electronic Periodical Service, CINAHL, and the Cochrane Central Register of Controlled Trials (CENTRAL). Eight trials (1,068 participants) were included in their review. After removing ineligible trials and any that had already been included in this review by WHO, one trial (311 participants with a mean age of 81 years) was

added to the scope review. The trial intervention was t'ai chi for 48 weeks.

Daniels et al. conducted a systematic review of intervention studies to prevent disability in community-dwelling physically frail older adults. The PubMed, Cochrane Central Register of Controlled Trials (CENTRAL) and CINAHL databases were searched in May 2007. Ten studies were included in their review. Out of the 10 studies, seven were excluded by this review by WHO (two had been included in the scope review, two included an active control, two combined nutrition programmes, and one included a home-safety programme). The three selected studies (277 participants) for this scope review were randomized controlled trials published by authors from Denmark, Netherlands, and USA. Participants either had mobility limitations or were considered frail. The mean age ranged from 77 to 81 years. The sample size ranged from 46 to 155 participants. The exercise duration ranged from 12 weeks to 10 months. All three trials used multimodal exercise.

de Vries et al. conducted a meta-analysis to evaluate the effects of physical exercise therapy on mobility, physical functioning, physical activity and quality of life in community-dwelling older adults with mobility limitations. The PubMed, CINAHL, EMBASE, PEDro and Cochrane Library databases were searched in May 2011 and 18 studies were included. Four of the 18 studies (734 participants) were added to this scope review. The lead authors of the selected trials were from Australia, Denmark and USA. Participants either had mobility limitations or a recent fall history. The mean age of the trial participants ranged from 75 to 78 years. The sample size

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ranges from 72 to 424 participants. The exercise duration ranges from 5 weeks to 1 year. All four trials used multimodal exercise.

Giné-Garriga et al. (2014) conducted a systematic review and meta-analysis on physical exercise for improving performance-based measures of physical function in frail older adults living in the community. MEDLINE, Cochrane Library, PEDro, and CINAHL databases were searched in April 2013 and 19 trials were included. Two of the 19 studies (99 participants) were added to this scope review. The lead authors of these two trials were from Sweden and USA. The mean age of the trial participants was 70 and 83 years, respectively. The samples size was 53 and 46 participants, respectively. The exercise duration was 12 weeks or 1 year. Both trials used multimodal exercise.

Howe et al. (2011) conducted a Cochrane systematic review of exercise interventions on balance in older people. Cochrane Bone, Joint and Muscle Trauma Group, Cochrane Central Register of Controlled Trials (CENTRAL; 2011, Issue 1), MEDLINE and EMBASE (to February 2011) databases were searched. The review included 94 trials (9,821 participants). Three randomized controlled trials (240 participants) were selected and included in this scope review based on the criterion on population. These three trials were published by authors from Japan and USA. Participants either had functional limitations (self-reported) or were frail. The mean age of participants ranged from 70 to 74 years. The sample size ranged from 49 to 132 participants. The exercise duration ranged from 8 to 24 weeks. One trial used progressive resistance exercise, one multimodal exercise, and one t'ai chi.

Liu and Latham (2009) conducted a Cochrane systematic review of the effect of progressive resistance strength training on improving physical function in older adults. Cochrane Bone, Joint and Muscle

Trauma Group (to March 2007), Cochrane Central Register of Controlled Trials (CENTRAL; 2007, Issue 2), MEDLINE (1966 to 1 May 2008), EMBASE (1980 to 6 February 2007), CINAHL (1982 to 1 July 2007) and two other electronic databases were searched (till March 2007). Although 121 randomized controlled trials (6,700 participants) were included in Liu and Latham's review, only 10 trials were initially included in this scope review. One trial did not have outcomes relevant to this review so was excluded from further review. The remaining nine trials (715 participants) were published by authors from Australia, Netherlands, New Zealand, UK, and USA. Participants either had physical performance limitations, difficulty rising from a chair or weak leg muscle strength. The mean age of participants ranged from 71 to 81 years. The sample size ranged from 16 to 243 participants. The exercise duration ranged from 8 to 25 weeks (12 weeks or under for 6 trials). This review was updated by WHO in 2015, and two additional trials were included in the evidence synthesis.

van Abbema et al. (2015) conducted a meta-analysis to evaluate the effect of exercise on gait speed in older adults. Studies published between 1990 and 2013 were searched in PubMed, EMBASE, EBSCO (Allied and Complementary Medicine Database [AMED], CINAHL, Education Resources Information Center (ERIC), MEDLINE, PsycINFO and SocINDEX), and Cochrane Library databases. van Abbema et al. included 25 trials (2389 participants) in their review. After removing ineligible and duplicate studies, three trials (226 participants) were added to this scope review. The lead authors were from Spain, Japan or Australia. Participants were either frail or had geriatric syndromes or concerns about balance. All three trials used multimodal exercise for 3 months or 6 months.

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### Systematic reviews on physical exercise for older people with dementia

Burton et al. (2015) conducted a systematic review and meta-analysis to evaluate the effect of exercise programmes to reduce falls in older adults with dementia. Studies published between January 2000 and February 2010 were searched in PubMed, MEDLINE (ProQuest), PsycINFO, EMBASE, CINAHL and Scopus databases in 2014. Four trials (336 participants) were included in their review. After removing ineligible trials, two trials published from Finland and Australia (250 participants with a mean age of 78 and 82 years, respectively) were added to this scope review. Both trials used multimodal exercise for 6 months or 12 months. One trial delivered exercise that was either group-based or home-based. The other trial was of an individualized exercise programme.

Forbes et al. (2015) conducted a Cochrane systematic review of exercise programmes for people with dementia to improve cognition, activities of daily living, and behavioural and psychological symptoms. They identified and reviewed 17 trials (1067 participants) using the following databases: MEDLINE, PsycINFO, EMBASE, CINAHL, CENTRAL, LILACS, ALOIS,

ClinicalTrials.gov and Web of Science (the search was conducted in 2013). Two trials (67 participants) were added to this scope review. These were published by authors from Australia and USA. The mean age of participants was 74 and 75 years, respectively. Both trials used multimodal exercise daily, for 12 weeks or 4 months, respectively. One trial (Steinberg et al. 2009) was not included in the final effect-size calculation in this scope review because the mean and standard deviation of post-test were not reported.





Pitkälä et al. (2013) conducted a systematic review to evaluate the effect of physical exercise on mobility and physical functioning in older adults with dementia. Studies published through August 31 2011 were searched in the following databases: PubMed, Cochrane Library, Cochrane Database of Abstracts of Reviews of Effects (DARE), CINAHL and Nursing@Ovid. Twenty randomized controlled trials (1378 participants) were included in the review. After removing ineligible trials and any that had already been included in this scope review, four trials (160 participants with mean ages ranging from 76.9 to 81.9 years) published from France, Israel, Korea and UK were added to this review. All trials used multimodal exercise with a duration ranging from 2 weeks to 12 months.

**GRADE table 1: Progressive resistance training compared with control for older people with limitations in daily activities**

**Authors:** WHO systematic review team  
**Date:** 25 October 2015  
**Question:** Does progressive resistance exercise compared with control produce any benefit or harm for older people with limitations in activities of daily living (ADL)?  
**Setting:** Community  
**Bibliography:** Liu C, Latham N. Progressive resistance strength training for improving physical function in older adults. *Cochrane Database Syst Rev.* 2009;(3):CD002759. doi:10.1002/14651858.CD002759.pub2. (Systematic review was updated by WHO in 2015.)

Quality assessment							Number of patients		Effect	Quality	Importance
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Progressive resistance exercise	control	Absolute (95% CI)		
<b>Balance</b> (follow-up 8–24 weeks; assessed with one-leg stand, functional reach, Berg balance scale, FICSIT balance test; higher score = better performance)											
7	randomized trials	serious <sup>a</sup>	not serious	not serious	not serious	none	291	302	SMD 0.09 higher (0.16 lower to 0.33 higher)	▣▣▣▣ MODERATE	CRITICAL
<b>Gait speed</b> (follow-up 8–24 weeks; assessed with timed walk; higher score = better performance)											
7	randomized trials	serious <sup>b</sup>	serious <sup>c</sup>	not serious	not serious	none	241	237	SMD 0.19 higher (0.11 lower to 0.49 higher)	▣▣▣▣ LOW	IMPORTANT
<b>Chair stand</b> (follow-up 6–12 months; assessed with five chair stands; lower score = better performance)											
2	randomized trials	serious <sup>d</sup>	not serious	not serious	very serious <sup>a</sup>	none	20	18	MD 4.01 seconds lower (7.3 lower to 0.72 lower)	▣▣▣▣ VERY LOW	CRITICAL

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Quality assessment							Number of patients		Effect	Quality	Importance
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Progressive resistance exercise	control	Absolute (95% CI)		
<b>Timed up and go</b> (follow-up 8–24 weeks; assessed with timed up and go; lower score = better performance)											
6	randomized trials	serious <sup>f</sup>	not serious	not serious	not serious	none	270	266	MD 0.54 seconds lower (1.99 lower to 0.92 higher)	 MODERATE	CRITICAL
<b>Overall physical functioning</b> (follow-up 10–12 weeks; assessed with Short Physical Performance Test, SF36-physical functioning; higher score = better performance)											
3	randomized trials	serious <sup>g</sup>	not serious	not serious	not serious	none	168	169	SMD 0.01 higher (0.27 lower to 0.28 higher)	 MODERATE	CRITICAL
<b>ADLs</b> (follow-up 10–16 weeks; assessed with Groningen Activity Restriction Scale, Barthel Index, Continuous Scale Physical Functional Performance; higher score = better performance)											
4	randomized trials	not serious	not serious	not serious	not serious	none	150	159	SMD 0.04 higher (0.19 lower to 0.27 higher)	 HIGH	CRITICAL
<b>Muscle strength of the lower extremity</b> (follow-up 8–24 weeks; higher score = better performance)											
8	randomized trials	serious <sup>h</sup>	serious <sup>i</sup>	not serious	not serious	none	328	327	SMD 0.32 higher (0.07 higher to 0.58 higher)	 LOW	CRITICAL

ADLs: activities of daily living; MD: mean difference; RR: relative risk




- Risk of bias: Downgraded once as allocation concealment was unclear in four trials and information on incomplete data was not adequately described in three trials.
- Risk of bias: Downgraded once as allocation concealment was unclear in three trials and procedure for masking outcome assessor was unclear in two trials.
- Inconsistency: Downgraded once as moderate heterogeneity was observed in the meta-analysis ( $\text{Tau}^2 = 0.01$ ;  $\text{Chi}^2 = 12.80$ ,  $\text{df} = 6$  ( $P = 0.03$ ;  $I^2 = 61\%$ )).
- Risk of bias: Downgraded once as outcome assessor was not masked in one trial.
- Imprecision: Downgraded twice as sample size was very small.
- Risk of bias: Downgraded once as allocation concealment was unclear in four trials and procedure for masking outcome was unclear in three trials.
- Risk of bias: Downgraded once as information on incomplete data was unclear in two trials.
- Risk of bias: Downgraded once as allocation concealment was unclear in five trials and outcome assessors were not masked in three trials.
- Inconsistency: Downgraded once as moderate heterogeneity was observed in the meta-analysis ( $\text{Tau}^2 = 0.14$ ;  $\text{Chi}^2 = 33.17$ ,  $\text{df} = 7$  [ $P = 0.0007$ ];  $I^2 = 69\%$ ).

**GRADE table 2: Multimodal exercise training compared with controls for older people with limitations in daily activities**

<b>Authors:</b>	WHO systematic review team
<b>Date:</b>	24 October 2015
<b>Question:</b>	Does multimodal exercise compared with control produce any benefit or harm for older people with limitations in activities of daily living (ADL)?
<b>Setting:</b>	Community
<b>Bibliography:</b>	<p>Cadore EL, Rodríguez-Mañas L, Sinclair A, Izquierdo M. Effects of different exercise interventions on risk of falls, gait ability, and balance in physically frail older adults: a systematic review. <i>Rejuvenation Res.</i> 2013;16:105–14. doi:10.1089/rej.2012.1397.</p> <p>Chou C-H, Hwang C-L, Wu Y-T. Effect of exercise on physical function, daily living activities, and quality of life in the frail older adults: a meta-analysis. <i>Arch Phys Med Rehabil.</i> 2012;93:237–44. doi:10.1016/j.apmr.2011.08.042.</p> <p>Daniels R, van Rossum E, de Witte L, Kempen GJ, van den Heuvel W. Interventions to prevent disability in frail community-dwelling elderly: a systematic review. <i>BMC Health Serv Res.</i> 2008;8:278. doi:10.1186/1472-6963-8-278.</p> <p>de Vries N, van Ravensberg C, Hobbelen J, Olde Rikkert MGM, Staal JB, Nijhuis-van der Sanden MWG. Effects of physical exercise therapy on mobility, physical functioning, physical activity and quality of life in community-dwelling older adults with impaired mobility, physical disability and/or multi-morbidity: a meta-analysis. <i>Ageing Res Rev.</i> 2012;11(1):136–49. doi:10.1016/j.arr.2011.11.002.</p> <p>Giné-Garriga M, Roqué-Fíguls M, Coll-Planas L, Sitjà-Rabert M, Salvà A. Physical exercise interventions for improving performance-based measures of physical function in community-dwelling, frail older adults: a systematic review and meta-analysis. <i>Arch Phys Med Rehabil.</i> 2014;95:753–69.e3. doi:10.1016/j.apmr.2013.11.007.</p> <p>Howe T, Rochester L, Neil F, Skelton D, Ballinger C. Exercise for improving balance in older people. <i>Cochrane Database Syst Rev.</i> 2011;(11):CD004963. doi:10.1002/14651858.CD004963.pub3.</p> <p>van Abbema R, De Greef M, Crajé C, Krijnen W, Hobbelen H, Van Der Schans C. What type or combination of exercise can improve preferred gait speed in older adults? A meta-analysis. <i>BMC Geriatr.</i> 2015;15:72. doi:10.1186/s12877-015-0061-9.</p>

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Quality assessment							Number of patients		Effect	Quality	Importance
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Multimodal exercise	Control	Absolute (95% CI)		
<b>Balance</b> (follow-up 12–18 months; assessed with Berg balance scale, functional reach, modified Romberg test, single-leg stand, Tinetti balance score; higher score = better performance)											
16	randomized trials	not serious	serious <sup>a</sup>	not serious	not serious	none	642	671	SMD 0.43 higher (0.15 higher to 0.7 higher)	MODERATE	CRITICAL
<b>Gait speed</b> (follow-up 12–18 months; assessed with timed walk; higher score = better performance)											
15	randomized trials	not serious	serious <sup>b</sup>	not serious	not serious	none	749	794	SMD 0.26 higher (0 to 0.52 higher)	MODERATE	IMPORTANT
<b>Chair stand</b> (follow-up 5 weeks to 18 months; assessed with five chair stands, number of chair stand repetitions; lower score = better performance)											
9	randomized trials	not serious	serious <sup>c</sup>	not serious	not serious	none	402	425	SMD 0.41 lower (0.77 lower to 0.04 lower)	MODERATE	CRITICAL
<b>Timed up and go</b> (follow-up 12 weeks to 16 months; assessed with timed up and go and modified timed up and go; lower score = better performance)											
5	randomized trials	serious <sup>d</sup>	serious <sup>e</sup>	not serious	serious <sup>f</sup>	none	149	156	SMD 0.93 lower (1.87 lower to 0.01 higher)	VERY LOW	CRITICAL <i>(continued next page)</i>

<b>Overall physical functioning</b> (follow-up 12 weeks to 18 months; assessed with eight-item physical performance test, modified physical performance test, SF36-physical functioning, Short Physical Performance Battery, Balance Outcome Measure for Elder Rehabilitation, Organization Quality of Life Instrument-physical domain; higher score = better performance)											
9	randomized trials	serious <sup>g</sup>	serious <sup>h</sup>	not serious	not serious	none	445	531	SMD 0.25 higher (0.08 higher to 0.43 higher)	 LOW	CRITICAL
<b>ADLs</b> (follow-up 12 weeks to 18 months; assessed with Barthel Index, functional status questionnaire, NHANES independence measure, The Older Americans Resources and Services ADL scale; higher score = better performance)											
7	randomized trials	not serious	serious <sup>i</sup>	not serious	not serious	none	276	275	SMD 0.73 higher (0.15 higher to 1.31 higher)	 MODERATE	CRITICAL
<b>Muscle strength of the lower extremity</b> (follow-up 12–18 months; assessed with muscle strength of knee extension, hip adductor or of quadriceps; higher score = better performance)											
10	randomized trials	not serious	serious <sup>j</sup>	not serious	not serious	none	631	628	SMD 0.24 higher (0.02 higher to 0.45 higher)	 MODERATE	CRITICAL

ADLs: activities of daily living; SMD: standardized mean difference

- a. Inconsistency: Downgraded once as substantial heterogeneity was observed in the meta-analysis for the estimate (heterogeneity:  $\text{Tau}^2 = 0.17$ ;  $\text{Chi}^2 = 2.18$ ,  $\text{df} = 15$   $P = 0.0007$ ;  $I^2 = 84\%$ ). This is mainly due to very large treatment effect from one of the included trials.
- b. Inconsistency: Downgraded once as considerable heterogeneity was observed in the meta-analysis for the estimate (heterogeneity:  $\text{Tau}^2 = 0.94$ ;  $\text{Chi}^2 = 3.92$ ,  $\text{df} = 4$  [ $P = 0.05$ ];  $I^2 = 75\%$ ). No further subgroup analysis was conducted to explore heterogeneity, and we were not able to explain the heterogeneity.
- c. Inconsistency: Downgraded once as moderate heterogeneity was observed in the meta-analysis for the estimate (heterogeneity:  $\text{Tau}^2 = 0.04$ ;  $\text{Chi}^2 = 33.50$ ,  $\text{df} = 8$  [ $P = 0.01$ ];  $I^2 = 52\%$ ). No further subgroup analysis was conducted to explore heterogeneity, and we were not able to explain the heterogeneity.
- d. Risk of bias: Downgraded once as allocation concealment and procedure for masking outcome assessors were unclear in two trials.
- e. Inconsistency: Downgraded once as moderate heterogeneity was observed in the meta-analysis for the estimate (heterogeneity:  $\text{Tau}^2 = 0.15$ ;  $\text{Chi}^2 = 3.31$ ,  $\text{df} = 4$  [ $P = 0.04$ ];  $I^2 = 67\%$ ). No further subgroup analysis was conducted to explore heterogeneity, and we were not able to explain the heterogeneity.
- f. Imprecision: Downgraded once as wide confidence intervals were observed for the estimate.
- g. Risk of bias: Downgraded once as outcome assessor was not masked in half of the included trials.
- h. Inconsistency: Downgraded once as moderate heterogeneity was observed for the estimate (heterogeneity:  $\text{Tau}^2 = 0.21$ ;  $\text{Chi}^2 = 12.11$ ,  $\text{df} = 7$  [ $P = 0.04$ ];  $I^2 = 61\%$ ). No further subgroup analysis was conducted to explore heterogeneity, and we were not able to explain the heterogeneity.
- i. Inconsistency: Downgraded once as moderate heterogeneity was observed for the estimate (heterogeneity:  $\text{Chi}^2 = 25.55$ ,  $\text{df} = 6$  [ $P = 0.02$ ];  $I^2 = 49\%$ ). No further subgroup analysis was conducted to explore heterogeneity, and we were not able to explain the heterogeneity.
- j. Inconsistency: Downgraded once as considerable heterogeneity was observed for the estimate (heterogeneity:  $\text{Tau}^2 = 0.85$ ;  $\text{Chi}^2 = 2.92$ ,  $\text{df} = 9$  [ $P = 0.04$ ];  $I^2 = 71\%$ ). No further subgroup analysis was conducted to explore heterogeneity, and we were not able to explain the heterogeneity.



**GRADE table 3: T'ai chi compared with control in older people with limitations in activities of daily living**


**Authors:** WHO systematic review team

**Date:** 24 October 2015

**Question:** Does t'ai chi compared with control produce any benefit or harm for older people with limitations in activities of daily living (ADL)?

**Setting:** Community

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Number of studies	Study design	Quality assessment					Number of patients		Effect		Quality	Importance
		Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	T'ai chi	control	Relative (95% CI)	Absolute (95% CI)		
<b>Balance</b> (follow-up 8 weeks to 12 months; assessed with single leg stand, Berg balance scale; higher score = better performance)												
3	randomized trials	serious <sup>a</sup>	serious <sup>b</sup>	not serious	not serious	none	231	117	–	SMD 0.25 higher (0.06 higher to 0.44 higher)	 LOW	CRITICAL  (continued next page)

Quality assessment							Number of patients		Effect		Quality	Importance
Number of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	T'ai chi	control	Relative (95% CI)	Absolute (95% CI)		
<b>Gait speed</b> (follow-up 8–48 weeks; assessed with timed walk; higher score = better performance)												
2	randomized trials	serious <sup>c</sup>	not serious	not serious	not serious	none	123	118	–	MD 0.04 higher (0.21 lower to 0.29 higher)	▣▣▣▣ MODERATE	IMPORTANT
<b>Chair stand</b> (follow up 48 weeks; assessed with time to rise from the chair, three times; lower score = better performance)												
1	randomized trials	not serious	not serious	not serious	very serious <sup>d</sup>	none	83	79	–	MD 0.53 lower (2.07 lower to 1.01 higher)	▣▣▣▣ LOW	CRITICAL
<b>ADLs</b> (follow up 12 months; assessed with Groningen Activity Restriction Scale; lower score = better performance)												
1	randomized trials	not serious	not serious	not serious	very serious <sup>e</sup>	none	138	93	–	MD 0.3 lower (2.51 lower to 1.91 higher)	▣▣▣▣ LOW	CRITICAL

ADLs: activities of daily living; MD: mean difference

- Risk of bias: Downgraded once as outcome assessor was not masked in one trial.
- Inconsistency: Downgraded once as considerable heterogeneity was observed in the meta-analysis for the estimate ( $\text{Chi}^2 = 2.59$ ,  $\text{df} = 2$  ( $P = 0.01$ );  $I^2 = 71\%$ ).
- Risk of bias: Downgraded once as allocation concealment and procedure for masking outcome assessor was unclear in one trial.
- Imprecision: Downgraded twice as sample size was small (less than 200) and wide confidence intervals was observed.
- Imprecision: Downgraded twice as wide confidence intervals was observed.

## Part 2: From evidence to recommendations

### Summary of evidence

Outcome	Effect size		
	Progressive resistance exercise	Multimodal exercise	T'ai chi
<b>Muscle strength</b> GRADE table 1, Liu et al.	SMD 0.32 higher (0.07 higher to 0.58 higher) LOW	SMD 0.24 higher (0.02 higher to 0.45 higher) MODERATE	–
<b>Balance</b> GRADE table 1, Liu et al.	SMD 0.09 higher (0.16 lower to 0.33 higher) MODERATE	SMD 0.43 higher (0.15 higher to 0.7 higher) MODERATE	SMD 0.25 higher (0.06 higher to 0.44 higher) LOW
<b>Gait speed</b> GRADE table 1, Liu et al.	SMD 0.19 higher (0.11 lower to 0.49 higher) LOW	SMD 0.26 higher (0 to 0.52 higher) MODERATE	MD 0.04 higher (0.21 lower to 0.29 higher) MODERATE
<b>Chair stand</b> GRADE table 1, Liu et al.	MD 4.01 lower (7.3 lower to 0.72 lower) VERY LOW	SMD 0.41 lower (0.77 lower to 0.04 lower) MODERATE	MD 0.53 lower (2.07 lower to 1.01 higher) LOW
<b>Timed up and go</b> GRADE table 1, Liu et al.	MD 0.54 lower (1.99 lower to 0.92 higher) MODERATE	SMD 0.93 lower (1.87 lower to 0.01 higher) VERY LOW	–
<b>Overall physical function</b> GRADE table 1, Liu et al.	SMD 0.01 higher (0.27 lower to 0.28 higher) MODERATE	SMD 0.25 higher (0.08 higher to 0.43 higher) LOW	–
<b>Activities of daily living (ADLs)</b> GRADE table 1, Liu et al.	SMD 0.04 higher (0.19 lower to 0.27 higher) HIGH	SMD 0.73 higher (0.15 higher to 1.31 higher) MODERATE	MD 0.3 flower (2.51 lower to 1.91 higher) LOW

## Evidence-to-recommendations table

Problem	Explanation
<p data-bbox="134 248 373 280">Is the problem a priority?</p> <p data-bbox="134 304 193 353">Yes ✓</p> <p data-bbox="264 304 293 327">No</p> <p data-bbox="357 304 448 327">Uncertain</p>	<p data-bbox="517 248 1422 383">Population studies have found that nearly 40% of older people experience limitations in performing daily activities. Evidence also suggests a strong relationship between declines in functional ability and adverse outcomes, such as mortality, institutionalization, falls, morbidities, depression, cognitive impairment and decreased quality of life. Addressing functional indicators (muscle strength and balance) is therefore crucial for attenuating adverse outcomes for older people.</p> <p data-bbox="1230 432 1433 454"><i>(continued next page)</i></p>

Benefits and harms	Explanation
<p data-bbox="135 197 507 250">Do the desirable effects outweigh the undesirable effects?</p> <p data-bbox="135 277 507 331"> <span data-bbox="135 277 191 331">Yes ✓</span> <span data-bbox="263 277 295 331">No</span> <span data-bbox="359 277 454 331">Uncertain</span> </p>	<p data-bbox="513 197 1439 228">Progressive resistance exercise in older people with limitations in physical function:</p> <ul data-bbox="513 228 1439 362" style="list-style-type: none"> <li data-bbox="513 228 1439 282">• There is low-quality evidence for the effect of progressive resistance exercise on increasing muscle strength.</li> <li data-bbox="513 282 1439 362">• There is very low-quality evidence for the effect of progressive resistance exercise on improving chair stand performance.</li> </ul> <p data-bbox="513 385 1439 416">Multimodal exercise in older people with limitations in physical function:</p> <ul data-bbox="513 416 1439 685" style="list-style-type: none"> <li data-bbox="513 416 1439 470">• There is moderate-quality evidence for the effect of multimodal exercise on increasing muscle strength.</li> <li data-bbox="513 470 1439 524">• There is moderate-quality evidence for the effect of multimodal exercise on improving balance.</li> <li data-bbox="513 524 1439 577">• There is moderate-quality evidence for the effect of multimodal exercise on improving chair stand performance.</li> <li data-bbox="513 577 1439 631">• There is low-quality evidence for the effect of multimodal exercise on improving overall physical function.</li> <li data-bbox="513 631 1439 685">• There is moderate-quality evidence for the effect of multimodal exercise on improving activities of daily living.</li> </ul> <p data-bbox="513 707 1439 739">T'ai chi in older people with limitations in physical function:</p> <ul data-bbox="513 739 1439 792" style="list-style-type: none"> <li data-bbox="513 739 1439 792">• There is low-quality evidence for the effect of t'ai chi on improving balance.</li> </ul> <p data-bbox="513 815 1439 918">Adverse events were reviewed if reported in the text. Musculoskeletal adverse events, such as muscle soreness and joint pain, were common among studies and might be related to exercise. Few studies reported severe adverse events such as fracture, hospitalization or death. The relationship between these severe events and exercise was not clear, however.</p> <p data-bbox="1228 922 1439 954" style="text-align: right;"><i>(continued next page)</i></p>

Values and preferences/ acceptability	Explanation
<p>Is there important uncertainty or variability about how much people value the options?</p> <p>Major variability    <b>Minor variability</b>    Uncertain</p> <p style="margin-left: 100px;">✓</p> <p>Is the option acceptable to key stakeholders?</p> <p>Major variability    <b>Minor variability</b>    Uncertain</p> <p style="margin-left: 100px;">✓</p>	<p>The GDG believes that this recommendation would be acceptable to older people and stakeholders. Multimodal exercise is consistent with the value of the promotion of their capacity and skills. Family members might also value the intervention when improved mobility is achieved. However, context-related issues might hamper the value of intervention in some settings, particularly in low- and middle-income countries. Therefore, adapting the intervention to the local context might be required in low- and middle-income countries. Further consultation with external advisory groups, and adaptation guides may be required to scale up interventions in culturally diverse settings.</p>
Feasibility/resource use	Explanation
<p>How large are the resource requirements?</p> <p><b>Major</b>    Minor    Uncertain</p> <p style="margin-left: 10px;">✓</p>	<p>Training, particularly involving the equipment for administering exercise interventions, is resource-intensive. However, the health benefit gained from the recommendation is likely to outweigh the resources required for implementation. Some factors can mitigate the cost, such as task-shifting, engaging with family members, and the training-of-trainers model.</p>
<p>Is the option feasible to implement?</p> <p><b>Yes</b>    No    Uncertain</p> <p style="margin-left: 10px;">✓</p>	<p>In this review, some trials involved non-specialist health-care professionals in the delivery of the exercise intervention. In low- and middle-income countries, non-specialist health-care workers/community health volunteers at primary care level/community level have been involved in</p> <p style="text-align: right;"><i>(continued next page)</i></p>

	delivering this public health intervention effectively. Such professionals can be trained to provide care for older people. However, whether existing staff can be involved or not requires further discussion with policy-makers and key stakeholders. A separate cadre of non-specialist health workers for geriatric care might be necessary.
<b>Equity</b>	<b>Explanation</b>
<p>Would the option improve equity in health?</p> <p>Yes      No      Uncertain</p> <p>✓</p>	<p>The GDG strongly believes that this recommendation will increase equity in health. Adherence to physical exercises without assistance is more prominent in higher-income and better-educated older populations.</p>

## Guideline development group recommendation and remarks

Recommendation
<p><b>Multimodal exercise, including progressive strength resistance training and other exercise components (balance, flexibility and aerobic training), should be recommended for older people with declining physical capacity, measured by gait speed, grip strength and other physical performance measures.</b></p> <p><i>Strength of the recommendation: Strong</i></p> <p><i>Quality of evidence: Moderate</i></p>
Remarks
<ul style="list-style-type: none"> <li>• The effects and quality of evidence for stand-alone progressive resistance training and t'ai chi were not considered sufficient for incorporation into the recommendation.</li> <li>• The duration of multimodal exercise intervention ranged from 2.7 to 12 months.</li> <li>• The frequency of training was most commonly 3 days per week.</li> <li>• There was a marked heterogeneity in the exercise components included in multimodal exercise trials. It may be important to distinguish the effect size for different combinations of exercises for a more accurate estimate of the effects.</li> <li>• The majority of the trials included in the systematic reviews were conducted in high-income countries. There may be limitations in generalizing this evidence to low-resource health-care settings.</li> <li>• The average age of the older people recruited in the trials evaluated may be over that of a target population in low- and middle-income countries. This may influence the generalizability of these findings to these populations.</li> </ul> <p style="text-align: right;"><i>(continued next page)</i></p>



- Compliance rates were found to decline in multimodal training programmes that used a transition approach – starting, that is, with group exercise classes with a high level of supervision, and then reducing the frequency of these classes as home-based exercises were added in.
- Commitments to, and compliance with, training programmes are crucial to achieving optimal benefits. Supervision by trained professionals may therefore be needed for high-intensity exercise and home-based training programmes.
- Exercise programmes designed for older adults with limitations in cognitive function should be tailored to meet individual needs, and should be delivered with more flexibility in a less structured manner than programmes for older people without impaired cognitive function.

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- Chin AP, Van Uffelen JGZ, Riphagen I, et al. The functional effects of physical exercise training in frail older people: a systematic review. *Sport Med*. 2008;38(9):781–93. doi:10.2165/00007256-200838090-00006 — *The review scope is overlapped with other reviews which have been included.*
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- Liu-Ambrose T, Donaldson MG. Exercise and cognition in older adults: is there a role for resistance training programmes? *Br J Sports Med*. 2009;43(1):25–7. doi:10.1136/bjism.2008.055616 — *Narrative review.*
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## Annex 1: Search strategy

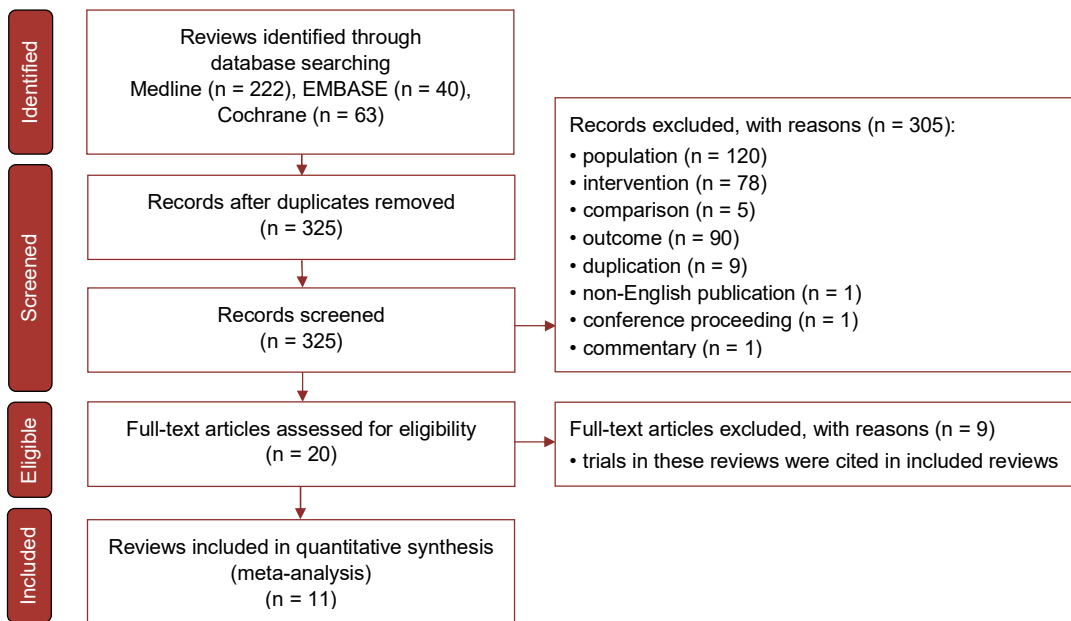
### MEDLINE database

1. ((strength\$ or resist\$ or weight\$) adj3 training).tw.
2. progressive resist\$.tw.
3. or/1-2
4. Exercise/
5. Exercise Therapy/
6. exercise\$.tw.
7. or/4-6
8. (Resist\$ training or strength\$).tw.
9. and/7-8
10. or/3,9
11. limit 10 to ("all aged (65 and over )" or "aged(80 and over)")
12. (elderly or senior\$).tw.
13. and/10,12
14. or/11,13
15. randomized controlled trial.pt.
16. controlled clinical trial.pt.
17. Randomized Controlled Trials/
18. Random Allocation/
19. Double Blind Method/
20. Single Blind Method/
21. or/15-20
22. Animals/ not Humans/
23. 21 not 22
24. clinical trial.pt.
25. exp Clinical Trials as topic/
26. (clinic\$ adj25 trial\$).tw.
27. ((singl\$ or doubl\$ or trebl\$ or tripl\$) adj25 (blind\$ or mask\$)).tw.
28. Placebos/
29. placebo\$.tw.
30. random\$.tw.
31. Research Design/
32. or/24-31
33. 32 not 22
34. 33 not 23
35. or/23,34
36. and/14,35

### Embase database (updated on 15 April 2011 )

1. ((strength\$ or resist\$ or weight\$) adj3 training).tw.
2. progressive resist\$.tw.
3. or/1-2
4. Exercise/
5. Kinesiotherapy/ or Therapy Resistance/
6. exercise\$.tw.
7. or/4-6
8. (resist\$ or strength\$).tw.
9. and/7-8
10. or/3,9
11. limit 10 to aged <65+ years>
12. (elderly or senior\$).tw.
13. and/10,12
14. or/11,13
15. Clinical trial/
16. Randomized controlled trial/
17. Randomization/
18. Single blind procedure/
19. Double blind procedure/
20. Crossover procedure/
21. Placebo/
22. Randomized controlled trial\$.tw.
23. Rct.tw.
24. Random allocation.tw.
25. Randomly allocated.tw.
26. Allocated randomly.tw.
27. (allocated adj2 random).tw.
28. Single blind\$.tw.
29. Double blind\$.tw.
30. ((treble or triple) adj blind\$).tw.
31. Placebo\$.tw.
32. Prospective study/
33. or/15-32
34. Case study/
35. Case report.tw.
36. Abstract report/ or letter/
37. or/34-36
38. 33 not 37
39. limit 38 to human
40. and/14,39

## Annex 2: PRISMA<sup>2</sup> flow diagram for mobility loss



<sup>2</sup> Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). For more information: <http://www.prisma-statement.org>