

Falls Prevention in Dementia: Literature Review

Goldup H*

Greater Manchester Mental Health, UK

Abstract

Falls are common in the elderly and increase with age. One third of people over the age of 65 will fall at least once in a year. This figure increases to half in people over the age of 80. They are the most common cause of death from injury in people over 65 and cost the NHS over £2 billion a year. Older people with dementia and cognitive impairment have been shown to fall twice as much as their cognitively intact peers. NICE recommends that falls prevention programmes should be multifactorial and incorporate strength and balance training, home hazard assessments and interventions, vision assessment and referral with medication review. There is, however, evidence to suggest that this type of intervention may not be as effective in people with dementia at reducing falls. The purpose of this literature review is to examine recent evidence to establish if there are any effective interventions to reduce falls in those with dementia.

Conclusion: Evidence for effective fall prevention programs in dementia is limited and often conflicting. Further research is needed to address what is a significant problem that is likely to increase as the world ages and rates of dementia increase. At this present time, there is insufficient evidence to support the use of any intervention to prevent falls in those with dementia. In the meantime, hospital trusts and care homes may need to consider novel approaches to reducing falls.

Keywords: Dementia; Medications; Cognitive; Impairment; Behaviour; Alzheimer's disease

Introduction

Falls are common in the elderly and increase with age. One third of people over the age of 65 will fall at least once in a year. This figure increases to half in people over the age of 80 [1]. They are the most common cause of death from injury in people over 65 and cost the NHS over £2 billion a year [2]. Older people with dementia and cognitive impairment have been shown to fall twice as much as their cognitively intact peers with an annual falls rate of around 60% [3,4]. Worldwide there are 47.5 million people living with dementia with figures set to rise to 132 million by 2050 [5,6]. Despite this, there is no specific guidance on fall prevention for this high-risk group in the UK. NICE recommends that falls prevention programmes should be multifactorial and incorporate strength and balance training, home hazard assessments and interventions, vision assessment and referral with medication review. There is, however, evidence to suggest that this type of intervention may not be as effective in people with dementia at reducing falls, and falls risk, as it is in those without cognitive impairment [7]. The purpose of this literature review is to examine recent evidence to establish if there are any effective interventions to reduce falls in those with dementia.

Risk Factors

A prospective study involving 109 older people with cognitive impairment in residential care found several significant risk factors when comparing fallers to non-fallers [8]. Increasing age, fall within the last year, lower Barthel score (poorer performance in ADLs), taking an antidepressant and being on more than 5 medications were all found to be associated with being a faller. Fallers were also more likely to have performed poorly in gait and balance measures and have increased levels of impulsivity, challenging behaviour and anxiety, along with lower ACE-R scores, particularly in Attention and Orientation, memory and fluency. A large prospective cohort trial published in 2017 reported similar results [9]. They found that while global cognitive impairment itself was not an independent risk factor for falls, poorer executive

function, anxiety and depression, processing speed and visuospatial impairment were. Poorer executive function has also been shown to increase falls risk in those without dementia [10]. A further prospective study published in 2013 had similar findings in community dwelling older adults with cognitive impairment [11]. Falls were significantly associated with mobility aid use, falls in the previous year, centrally acting medication and increasing number of medications. Poorer performance on visuospatial domain of the ACE-R, cube drawing and Trails A and B and higher GDS and Goldberg Anxiety Scale were all associated with increased falls rate. Poorer performance in balance and mobility tests was also shown to be linked with higher rates of falls. Neither of these trials compared those with cognitive impairment to those without. A prospective trial from 2007 did, and involved people in long-term care, both with and without dementia [12]. They found that there was a significantly increased risk of falling in patients with dementia who were male and walked with an aid. This was not found to be a significant risk factor in those without dementia, or in females with dementia. The authors suggested this may be due to men with dementia being more prone to impulsivity than women resulting in a higher falls risk. They concluded that it was more difficult to predict falls in people with dementia, as the risk factors for falls did not appear to be as clear cut as for older people without dementia. They felt that this highlighted that the circumstances surrounding the fall may be more important than predictive risk factors in this group. This was, however, a trial that included only those in long term care making it difficult to compare to other trials that have included a mixed sample or predominantly

*Corresponding author: Hannah Goldup, Physicians, Greater Manchester Mental Health, UK, Tel: +01971512923186; E-mail: hannah.goldup@gmmh.nhs.uk

Received November 29, 2017; Accepted December 04, 2017; Published December 15, 2017

Citation: Goldup H (2017) Falls Prevention in Dementia: Literature Review. J Dement 2: 105.

Copyright: © 2017 Goldup H. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

community dwelling older people such as Taylor et al. [13]. They similarly compared those with and without cognitive impairment and found that those with cognitive impairment performed worse on measures of reaction time, muscle strength, balance and mobility, all of which have been shown to increase falls risk in those without cognitive impairment. This suggests that falls risk factors in those with cognitive impairment may actually be the same as in those without cognitive impairment; they may just be present at increased rates in this group, thus explaining the increased falls rate.

The type of dementia a person has is also important in predicting falls risk. A trial that recruited 140 people with mild to moderate dementia, plus 39 controls, and then further divided them by diagnosis found that, unsurprisingly, falls were most highly associated with Lewy Body Dementia and Parkinson's disease Dementia [14]. There was, however, no significant difference between Alzheimer's disease and Vascular Dementia. They found that symptomatic orthostatic hypotension and depression were significantly linked with falls and that physical activity was protective against falls. Other larger studies however, have found no significant relationship between physical activity and falls. A further study also showed that malnutrition may be also associated with increased falls risk in people with dementia [15].

Multifactorial Interventions

NICE currently recommends that patients deemed to be high risk of falling should receive a multifactorial falls intervention to reduce the risk of further falls. However, evidence for their effectiveness in those with dementia is scarce and mixed. Shaw et al. looked at whether multifactorial intervention following a fall may prevent further falls in people with dementia [7]. Their sample comprised of people with dementia, presenting to Accident and Emergency departments following a fall, in Newcastle upon Tyne in 2003. This was a fairly large randomised control trial with 144 controls and 130 in the intervention group in the final analysis. All participants had a multifactorial assessment (medical, physiotherapy, occupational therapy and cardiovascular) and those in the intervention group received interventions targeting any risks detected. At three months, the multifactorial assessment was repeated. Patients were followed up for 1 year and their primary outcome was the number of people who fell. However, they also looked at other outcomes such as: time to first fall, injuries related to falls and A&E attendances due to falls. They found no significant difference in any outcome in the intervention group. While there was a 10% reduction in the number of people who fell in the intervention group, this was not statistically significant. They did note that some participants in the control group may have received interventions that were similar to those in the intervention group. However, other than in medication review where there was a 14% equivalent compliance rate in the control group, all were at a rate of less than 10%. They concluded that multifactorial intervention was less effective at reducing falls in people with dementia than it is in those without.

Another RCT from 2003 drew similar conclusions [16]. Participants were 378 care-home residents in Sweden. In this study, they also separated those with higher (above 19) and lower (below 19) MMSE scores. Interventions were similar to in the previously mentioned trial and included staff education, environmental modifications, exercise, medication review, use of hip protectors and post fall problem solving conferences. The time to first fall was only significantly reduced in the higher MMSE intervention group when compared to the control group. This was the same across most outcome measures. The only

significant result for the lower MMSE group was a reduction in the number of hip fractures in the intervention group. The authors felt that from their results they could not conclude that the intervention had no positive effect in those with cognitive impairment, but that it suggested this type of intervention was less effective in those with increasing levels cognitive impairment.

In contrast to the above studies, a large clustered randomised controlled trial in Germany investigated the effects of a multifaceted intervention on falls rates in nursing home residents which included a significant cohort of residents with cognitive impairment [17]. They found that time to first fall was significantly increased in the cognitively impaired group, but not the cognitively intact group when compared to their respective control groups. They also found that the intervention appeared to reduce the rate of falls in the cognitively impaired group more than in the cognitively intact group. This suggests that this type of intervention does benefit those with cognitive impairment. These findings are also supported by a similar trial that involved psychogeriatric nursing home residents [18]. They found that a multifactorial intervention program significantly reduced the number of falls in these residents. This trial did not specifically target those with dementia, but the average MMSE scores were 7 and 9.3 in the control and intervention group, respectively, suggesting that a high proportion of the residents were cognitively impaired.

Exercise Interventions

Other trials have focused on exercise alone as a way of reducing falls in this high-risk group. This is potentially a promising area to look at given that Allan et al. found exercise to be a protective factor when it comes to falls in people with dementia. Several different types of exercise have been looked at including Tai Chi, Yoga, and other balance, strength and mobility exercises [14].

The use of Dyadic Tai Chi was explored by Yao et al. [19]. This was a small, uncontrolled trial, involving 22 home dwelling participants with a diagnosis of dementia. Dyadic Tai chi is described as being an application of the Positive Emotion-Motivated Tai Chi that emphasises enhanced communication using positive emotional motivators. These could be playing relaxing music, being given a reward before or after exercise and use of the sticky hand technique where the patient and caregiver are in constant physical contact. This enables the patient to participate and provides sensory stimulus to the patient. The two outcome measures were measures of the Timed up and Go test (TUG) and Unipedal Stance Time (UST). Both are assessments of mobility and balance. Improvements were shown in both outcome measures, but this was less marked in those with severe impairment. This may be because both tests rely on the patient understanding instructions and on them trying to the best of their ability. While results are encouraging, falls were not an outcome. Numbers were too small to test for significance and the outcome measure chosen may have been inappropriate for the patient group. What is encouraging though is that many of the participants completed the 16-week program and over half were moderately to severely impair. Another study that also included participants with moderate to severe dementia was a feasibility study that examined whether or not arm chair yoga could be used to improve balance and potentially reduce falls in people with moderate to severe Alzheimer's [20]. They found that all 9 participants could complete the program and showed improvements in measures of mobility, gait and balance. However, only the change in balance was statistically significant. Given the very small sample size, and the fact that falls were not an outcome measure, conclusions cannot be made

about the effectiveness of this intervention. It did, however, show that those with severe impairment could participate effectively.

Another area of interest has been home-based exercise programs with several pilot and feasibility trials exploring this in recent years. One such trial was a feasibility RCT from 2013 that involved 40 participants with mild to moderate Alzheimer's dementia [21]. The intervention group were given a 6 month personally tailored, physiotherapist supervised home exercise program. Exercises were designed to improve balance and strength, and also included a walking program. 11 out of 19 in the intervention group completed the program. Falls rate decreased by 33% in the intervention group and increased by 89% in the control group but, this was not statistically significant. Within this trial, they also looked at factors that influenced commencement and adherence to the program as a separate qualitative study [22]. They concluded that carers played a very important role in enabling participants to take part and should be included in future trials. Another feasibility study in 2013 included carers in the intervention [23]. They looked at the use of a personally tailored intervention program that included both exercise and home hazard assessments. They also provided carers with education about the participants' cognitive abilities and advice on task simplification specifically tailored according to cognitive ability. This trial also showed a reduction in the number of falls in the intervention group compared to controls but, given the very small sample of 22 participants significance could not be commented on.

Another trial that also made use of carers was a pilot trial from 2017 [24]. They tested a carer-enhanced exercise program to see if they could improve patients' balance and depressive symptoms. This was not an RCT and involved only 42 participants with dementia. People with MMSE scores below 12 were excluded and falls was not the primary outcome measure. The 6-month exercise program included balance and strength training and was individually tailored to each participant. Over the 6 months they were visited by a physiotherapist to check progress and to progress the exercise program if needed. A reduction in GDS scores was measured but was not significant. Measures of balance did show significant improvement but adherence was poor with only 52% still exercising at 6 months. Those who adhered to the program had significantly better balance than those who did not. A similar pilot trial that instead used a centre based exercise program also showed significant improvements in balance and mobility after a 3-month exercise program [25]. This improvement then declined 3 months after the program stopped. Interestingly there was some suggestion that the exercise program seemed to slow down the rate of cognitive decline. Again, however, falls were not a measured outcome.

While the previously discussed pilot and feasibility trials have shown promising, albeit mostly insignificant results, the most promising evidence comes from an RCT from 2013 that involved 194 home-dwelling participants with a diagnosis of Alzheimer's from Helsinki [26]. The data on falls comes from a sub-analysis of a trial looking at the effects of exercise on dementia in which they compared a home-based, individually tailored, twice weekly exercise program, a centre based 4 hours, twice weekly exercise program and a control group. For the purpose of this further analysis they pooled the two groups together as the interventions were similar. Both programs involved a mixture of balance, endurance and strength training, along with exercises designed to improve executive functioning and dual tasking. In those with mild dementia physical function decreased in both the intervention and the control group but the rate at which the participants decreased was significantly slower in the intervention group compared to controls. There was no significant difference in the moderately impaired group.

Interestingly though the rate of falls was halved in the intervention group with moderate to severe dementia with only a slight reduction in the mild intervention group. Their results suggest that exercises designed to target both physical and cognitive functioning may be an effective way of reducing falls in people with dementia.

Other

As well as exercise and more traditional multifactorial interventions researchers have often looked at alternative ways of reducing falls in people with cognitive impairment. Some of these included cognitive training, increased supervision, nutritional support and the use of olfactory stimulation using lavender.

In 2012, an RCT in Japan tested whether the use of lavender scented patches could reduce falls in elderly people in long term care facilities [27]. While the study did not specifically look at people with dementia, they do present data on the MMSE scores of participants that indicate most participants had some level of cognitive impairment. The intervention involved the use of a small transdermal patch scented with lavender that only the resident could smell. Falls and changes in behaviour were recorded by care home staffs that were blinded. Over the year there was a significant reduction in agitated behaviour in the intervention group from baseline and the rate of falls also reduced significantly. While the authors state that staff who recorded the falls were blinded, and that the scent on each patch was only detectible to those wearing them, it is hard to dismiss the possibility that staff may have been aware of the scent, un-blinding the study.

An RCT from Helsinki looked at improving nutrition as a way of reducing falls in people with Alzheimer's [28]. The trial included 99 community-dwelling participants with a confirmed diagnosis of Alzheimer's living at home with spouses. Each couple was visited by a dietician who assessed diet and gave nutritional advice. This included the use of nutritional drinks in cases where diet was insufficient or participants were unable to meet nutritional needs through diet alone. 78 participants completed the intervention that took place over a year and there was a significant reduction in the rate of falls in the intervention group.

Another small, non-blinded feasibility study took the approach of looking at cognitive training to improve balance in people with cognitive impairment. 20 participants were recruited with mild to moderate impairment [29]. The 10-week online brain exercise program was tailored to target executive function, attention, visuospatial, inhibition, dual-tasking ability and speed of processing. They found that participants improved in 4 out of the 5 measures of balance, but that the improvements were not significant. There was however significant reduction in GDS scores, whether this is specific result of the cognitive training or due to other factors is difficult to comment on given that there was no control group. All the participants were able to complete the training, meaning this is an area for potential, future research.

In Virginia, a dementia unit for veterans tested a simple way of reducing falls in their residents with a history of recurrent and frequent falls, by increasing supervision [30]. They selected two nursing assistants to provide increased input with the 8 residents with the highest falls incidents in the unit. They received training on falls prevention and on the mechanics of catching a falling patient, as well as methods to keep them occupied during the day. The project ran over 4 months and significantly reduced the number of falls in these residents from 112 to 62. As well as reducing falls they found that residents and relatives

responded well to the increased input and improved the relations between relatives and staff. This is a similar project to one set up in Burton Hospital NHS Foundation Trust [31]. They employed a team of nursing assistants who were based in a “virtual ward” who would be called upon to provide 1 to 1 input with confused, elderly, agitated patients. They would be allocated on a weekly basis and would be with the patient for as long as was needed. This meant that continuity of care was improved and the Trust did not have to rely on temporary and expensive agency staff to provide one to one observations. Doctors reported being asked to review agitated patients less, relatives reported feeling more secure about the care their loved ones were receiving and they reported that the falls rate had reduced to zero since the program had started.

Discussion

Several factors have consistently been identified as being associated with an increased risk of falling in those with dementia or cognitive impairment. Poorer executive function and visuospatial scores on testing, use of centrally acting medications, increasing number of medications along, poorer performance in tests of mobility and balance and psychiatric comorbidities such as symptoms of anxiety or depression have all been shown to be associated with higher falls risk. Lewy Body Dementia and Parkinson’s disease Dementia and behavioural disturbance are also associated with increased falls rates. Many of these risks are not modifiable and those that are pose further challenges. Take for example, depression. It has been identified as a risk factor associated with falls, unfortunately there is evidence to suggest that the use of antidepressants may also increase the risk of falls independent of the presence of depressive symptoms [32]. The same could be said about behavioural disturbances in this group, the medication we use to manage these have also been shown to be associated with increased falls risk [33,34]. This makes preventing falls in this group challenging and complicated. While there is a good evidence base supporting the use of multifactorial interventions reduces falls in the elderly the same cannot be said for those with dementia. There is limited research specifically looking at people with dementia. And, there are about as many papers supporting the effectiveness of multifaceted interventions as there are against. Out of the 4 RCTs included in this review 2 reported positive results and 2 reported no change in falls rate. Older RCTs have shown similarly mixed results with one RCT showing positive results and two showing no reduction in falls [35-37]. Most of research has involved either a majority of participants from nursing homes or has taken place in a nursing home setting meaning, that there is little research focussing on people living in the community. A systematic review of reviews in 2015 drew similar conclusions, that there was mixed and inconclusive evidence for the effectiveness of multifactorial interventions to reduce falls in older people with dementia. This was especially true for community dwelling older people as most studies were of people in care homes [38].

Exercise appears to be a potentially promising area for future research. One trial showed that physical activity appeared to be a protective factor when it comes to falls in dementia and a large RCT showed some positive findings in reducing the rate of falls in people with moderate to severe impairment. Exercise also appeared to slow down the rate of physical decline in those with mild impairment. Several smaller trials have also showed promising results when it comes to the use of exercises such as Tai Chi and Yoga in people with dementia. Most of these trials have been uncontrolled and too small to comment on significance and out of the 7 trials reporting positive results only 3 had falls as an outcome. A meta-analysis from 2017 reported similar

results, out of 6 trial included in their analysis only 2 reported falls as an outcome [38]. They have however, shown that even people with severe impairment are able to participate in these exercise programs if they are tailored accordingly.

While trials testing other methods such as increased supervision, the use of lavender patches and cognitive training reported positive findings, most of these trials were small, and many were un-blinded and uncontrolled. One blinded RCT looked at using lavender patches was open to significant bias. Unfortunately, bias was a problem in most of the studies included in this review due to falls being self-reported by participants or their carers, this is not a problem that is easy to solve. This needs to be given consideration in future research, as does the involvement of carers. Many of the feasibility trials showed that carer involvement was of huge importance when carrying out research in this area. While increased supervision and the creation of virtual wards of nursing assistants to provide increased input to high risk patients are both reported to have reduced falls, there have been no large trials exploring this further.

Conclusions

As previous reviews have found, evidence for effective fall prevention programs in dementia is limited and often conflicting. While areas such as exercise programs using carers to aid participation show promise, there have been only a small number of large RCTs to date. Further research is needed to address what is a significant problem that is likely to increase as the world ages and rates of dementia increase. At this present time, there is insufficient evidence to support the use of any intervention to prevent falls in those with dementia. In the meantime, hospital trusts and care homes may need to consider novel approaches to reducing falls. Programs such as that in Burton Hospital NHS Foundation Trust have successfully reduced the rates of falls within the areas they have been implemented and may be of particular interest to Later Life inpatient teams who are keen to find ways to reduce falls on their units.

References

1. <https://www.nice.org.uk/guidance/CG161/chapter/Introduction>
2. Snooks H, Cheung WY, Gwini SM, Humphreys I, Sanchez A, et al. (2011) Can older people who fall be identified in the ambulance call centre to enable alternative responses or care pathways? *Emergency Medicine Journal* 28.
3. Tinetti ME, Speechley M, Ginter SF (1988) Risk factors for falls among elderly persons living in the community. *N Engl J Med* 319: 1710-1717.
4. Van Dijk PTM, Meulenberg OGRM, Van De Sande HJ, Habbema JDF (1993) Falls in dementia patients. *Gerontologist* 33: 200-204.
5. <http://www.who.int/mediacentre/factsheets/fs362/en/>.
6. Prince M, Wimo A, Guerchet M (2015) World Alzheimer Report 2015. World Alzheimer Report 2015: The Global Impact of Dementia. Alzheimer’s Disease international.
7. Shaw FE, Bond J, Richardson DA, Dawson P, Steen IN, et al. (2003) Multifactorial intervention after a fall in older people with cognitive impairment and dementia presenting to the accident and emergency department: randomised controlled trial. *BMJ* 326: 73.
8. Whitney J, Close JCT, Jackson SHD, Lord SR (2012) Understanding Risk of Falls in People living With Cognitive Impairment Living in Residential Care. *J Am Med Dir Assoc* 13: 535-540.
9. Taylor ME, Delbaere K, Lord SR, Kurrle SE, Close JC, et al. (2017) Reaction Time and Postural Sway Modify the Effect of Executive Function on Risk of Falls in Older People with Mild to Moderate Cognitive impairment. *Am J Geriatr Psychiatry* 4: 397-406.
10. Kearney F, Harwood RH, Gladman JRF, Lincoln N, Masud T (2013) The

- Relationship between Executive Function and Falls and Gait Abnormalities in Older Adults: A Systematic Review. *Dement Geriatr Cogn Disord* 36: 20-35.
11. Taylor ME, Delbaere K, Lord SR, Mikolaizak SA, Brodaty H, et al. (2014) Neuropsychological, Physical, and Functional Mobility Measures Associated With Falls in Cognitively Impaired Older Adults. *J Gerontol A Biol Sci Med Sci* 69: 987-995.
 12. Eriksson S, Gustafson Y, Landin-Olsson L (2008) Risk factors for falls in people with and without a diagnose of dementia living in residential care facilities: A prospective study. *Arch Gerontol Geriatr* 46: 293-306.
 13. Taylor ME, Delbaere K, Lord SR, Close JC, Mikolaizak AS (2013) Physical impairments in cognitively impaired older people: Implications for risk of falls. *Int Psychogeriatrics* 25: 148-156.
 14. Allan LM, Ballard CG, Rowan EN, Kenny RA (2009) Incidence and Prediction of Falls in Dementia: A Prospective Study in Older People. *PLoS One* 4: e5521.
 15. Meijers JMM, Halfens RJG, Neyens JCL, Verlaan G, Schols JM, et al. (2012) Predicting Falls In Elderly Receiving Home Care: The Role of Malnutrition and Impaired Mobility. *J Nutr Health Aging* 16: 654-658.
 16. Jensen J, Nyberg L, Gustafson Y, Lundin-Olsson L (2003) Fall and Injury Prevention in Residential Care-Effects in Residents with Higher and Lower Levels of Cognition. *J Am Geriatr Soc* 51: 627-635.
 17. Rapp K, Lamb SE, Büchele G, Lall R, Lindemann U, et al. (2008) Prevention of Falls in Nursing Homes: Subgroup Analyses of a Randomized Fall Prevention Trial. *J Am Geriatr Soc* 56: 1092-1097.
 18. Neyens CLJ, Dijcks BPJ, Twisk J, Schols JMGA, Van Haastregt JCM, et al. (2009) A multifactorial intervention for the prevention of falls in psychogeriatric nursing home patients, a randomised controlled trial. *Age Ageing* 38: 194-199.
 19. Yao L, Giordani BJ, Algase DL, You M, Alexander NB (2013) Fall Risk-Relevant Functional Mobility Outcomes in Dementia Following Dyadic Tai Chi Exercise. *West J Nurs Res*. 35: 281-296.
 20. McAffrey R, Park J, Newman D, Hagen D (2014) The Effect of Chair Yoga in Older Adults with Moderate and Severe Alzheimer's Disease. *Res Gerontol Nurs* 7: 171-177.
 21. Suttanon P, Hill KD, Said CM, Williams SB, Byrne KN, et al. (2013) Feasibility, safety and preliminary evidence of the effectiveness of a home-based exercise programme for older people with Alzheimer's disease: a pilot randomized controlled trial. *Clin Rehabil* 27: 427-438.
 22. Suttanon P, Hill KD, Said CM, Byrne KN, Dodd KJ (2012) Factors influencing commencement and adherence to a home-based balance exercise program for reducing risk of falls: perceptions of people with Alzheimer's disease and their caregivers. *Int Psychogeriatr* 24: 1172-1182.
 23. Wesson J, Clemson L, Brodaty H, Lord S, Taylor M, et al. (2013) Feasibility study and pilot randomised control trial of a tailored prevention program to reduce falls in older people with mild dementia. *BMC Geriatr* 13: 89.
 24. Taylor ME, Lord SR, Brodaty H, Kurrle SE, Hamilton S, et al. (2017) A home based, carer enhanced exercise program improved balance and falls efficacy in community-dwelling older people with dementia. *International Psychogeriatrics* 29: 81-91.
 25. Ohman H, Savikko N, Strandberg T, Kautiainen H, Raivio M, et al. (2016) Effects of Exercise on Functional Performance and Fall Rate in Subjects with Mild or Advanced Alzheimer's Disease: Secondary Analyses of a Randomized Controlled Study. *Dement Geriatr Cogn Disord* 41: 233-241.
 26. Sakamoto Y, Ebihara S, Ebihara T, Tomita N, Toba K, et al. (2012) Fall Prevention Using Olfactory Stimulation with Lavender Odor in Elderly Nursing Home Residents: A Randomized Controlled Trial. *J Am Geriatr Soc* 60: 1005-1011.
 27. Suominen MH, Puranen TM, Jyvakorpi SK, Eloniemi-Sulkava U, Kautiainen H, et al. (2015) Nutritional Guidance Improves Nutrient Intake and Quality of Life, and May Prevent Falls in Aged Persons with Alzheimer Disease Living with a Spouse (NuAD Trial). *J Nutr Health Aging* 19: 901-907.
 28. Smith-Ray R, Irmiter C, Boulter K (2016) Cognitive training among Cognitively Impaired Older Adults: A Feasibility Study Assessing the Potential Improvement in Balance. *Frontiers in Public Health* 4: 219.
 29. Detweiler MB, Kim KY, Taylor BY (2005) Focused supervision of high-risk fall dementia patients: A simple method to reduce fall incidence and severity. *American Journal of Alzheimer s Disease and Other Dementias* 20: 97-104.
 30. <https://www.nursingtimes.net/roles/older-people-nurses/hcas-providing-enhanced-care-to-dementia-patients/7001428.article?v=1>.
 31. Kerse N, Flicker L, Pfaff JJ, Draper B, Lautenschlager NT, et al. (2008) Falls, Depression and Antidepressants in Later Life: A Large Primary Care Appraisal. *PLoS ONE* 3: e2423.
 32. Katz IR, Rupnow M, Kozma C, Schneider L. (2004) Risperidone and falls in ambulatory nursing home residents with dementia and psychosis or agitation: secondary analysis of a double-blind, placebo-controlled trial. *Am J Geriatr Psychiatry* 12: 499-508.
 33. Hartikainen S, Lönnroos E, Louhivuori K (2007) Medication as a risk factor for falls: critical systematic review. *J Gerontol A Biol Sci Med Sci* 62: 1172-1181.
 34. Rubenstein LZ, Robbins AS, Josephson KR, Schulman BL, Osterweil D (1990) The value of Assessing Falls in an Elderly Population: a randomised clinical trial. *Ann Intern Med* 113: 308-316.
 35. Ray WA, Taylor JA, Meador KG, Thapa PB, Brown AK, et al. (1997) A randomized trial of a consultation service to reduce falls in nursing homes. *JAMA* 278: 557-562.
 36. Mulrow CD, Gerety MB, Kanten D, Cornell JE, De Nino LA, et al. (1994) A randomized trial of physical rehabilitation for very frail nursing home residents. *JAMA* 271: 519-524.
 37. Booth V, Logan P, Harwood R, Hood V (2015) Falls prevention interventions in older adults with cognitive impairment: A systematic review of reviews. *International Journal of Therapy and Rehabilitation* 22: 289-296.
 38. Lewis M, Peiris CL, Shields N (2016) Long-term home and community-based exercise programs improve function in community-dwelling older people with cognitive impairment: a systematic review. *J Physiother* 63: 23-29.