
Effectiveness of Interventions to Prevent Falls in People With Alzheimer's Disease and Related Dementias

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KEY WORDS

- accident prevention
- accidental falls
- Alzheimer disease
- treatment outcome

A systematic review was conducted to determine the effectiveness of interventions to prevent falls in people with Alzheimer's disease (AD) and related dementias. Twelve research reports met inclusion criteria. Studies reported on three types of intervention: (1) exercise- and motor-based interventions, (2) nursing staff-directed interventions, and (3) multidisciplinary interventions. Strategies were offered as single or multifaceted intervention programs. All types of intervention resulted in benefit, although the evidence for effectiveness is tentative because of the studies' limitations. More research is needed to better understand appropriate dosages of intervention. No evidence was found for the effectiveness of prevention programs accessed as part of occasional respite care. Occupational therapy was seldom involved in the interventions researched. Because effective fall prevention programs are embedded in people's daily routines and encouraged participation in occupation, the contribution occupational therapy practitioners can make to the care of people with AD has yet to be fully realized.

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Approximately one-third of community-dwelling people > age 65, or 5.8 million people, experience accidental falls each year in the United States (Centers for Disease Control and Prevention [CDC], 2008; Gillespie et al., 2009). This proportion increases to 50% once older adults reach age 80 (Rubenstein & Josephson, 2002).

A *fall* is “an unexpected event in which the participant comes to rest on the ground, floor, or lower level” (Lamb, Jorstad-Stein, Hauer, & Becker, 2005, p. 1618). Fall-related injuries are a significant cause of morbidity and mortality in older populations (McClure et al., 2005). Unintentional falls are the leading cause of death from injury in people \geq age 65, resulting in about 14,000 deaths each year (CDC, 2006). Nonfatal injuries from falls result in 1.8 million people \geq age 65 receiving treatment in emergency departments each year (CDC, 2006). As a result, about one-third of older adults who sustain a fall-related injury require help with activities of daily living (ADLs), and of these people, nearly two-thirds require help for \geq 6 mo (Schiller, Kramarow, & Dey, 2007). Falls can also have serious psychological consequences. Fear of falling and loss of confidence can result in self-restricted activity levels, leading to reduced physical function and social interaction (Vellas, Wayne, Romer, Baumgarner, & Garry, 1997). Falling puts a strain on the family and is an independent predictor of admission to a nursing home (Gaugler, Duval, Anderson, & Kane, 2007). The estimated total direct annual cost of all fall injuries for people \geq 65 exceeds \$19 billion (Stevens, Corso, Finkelstein, & Miller, 2006).

Many risk factors appear to be at play for people who fall, including age, acute and chronic illness, osteoporosis, reduced vision, and impaired cognitive status, among others (Berry & Miller, 2008; Tinetti, Doucette, Claus, & Marottoli, 1995; Vassallo et al., 2009). Dementia is an independent risk factor

for falling because of its associated impairments in judgment, gait, visual–spatial perception, and ability to recognize and avoid hazards (Swanenburg, de Bruin, Uebelhart, & Mulder, 2010; van Doorn et al., 2003).

The global prevalence of dementia is predicted to double every 20 yr (Ferri et al., 2005). The growing number of older adults who have Alzheimer's disease (AD) and the fact that they are more likely to fall suggest that morbidity and mortality related to falls will also increase, resulting in higher costs of care in the future. Occupational therapy practitioners have a special opportunity for prevention and intervention because they are educated in the assessment and treatment of many of the factors associated with falls. To meet the needs of this specific population, research evidence is needed to inform practice and justify the use of interventions designed to prevent falls with people with AD.

Falls often indicate underlying frailty or illness and thus require a broad approach to assessment and management. Most evidence about successful prevention strategies, however, is derived from less frail and more clinically stable people living in their own homes (Gillespie et al., 2009). Although the research literature on fall prevention strategies in general is abundant, such evidence may not translate to populations with a high prevalence of cognitive impairments, such as people with AD and related dementias. Moreover, occupational therapy practitioners may not have the time, access, and expertise to appraise the available research on efficacious practices. Therefore, in this systematic review we appraised the evidence for the effect of interventions to prevent falls in people with dementia.

Background Literature

Several interventions to prevent falls in the older adult population in general have been investigated. In a Cochrane systematic review of 111 randomized controlled trials (RCTs) of interventions to reduce the incidence of falls in community-dwelling older adults, Gillespie et al. (2009) reported that exercise-based interventions that included two or more motor performance skills (e.g., balance, strengthening, endurance) were the most effective in reducing the overall number of falls and number of people who fell. Additionally, participation in group exercise, tai chi, and individually tailored home exercise programs was also effective in reducing falls in this population. Gillespie et al. noted that multifactorial interventions targeted at risk factors had inconclusive results in reducing falls, but the best current evidence did support their use. Home safety evaluations seemed to be

effective in reducing falls only in people with visual impairments and others at high risk. Of interest was that gradual withdrawal of psychotropic medication reduced the rate of falls but not the risk of falling (Campbell, Robertson, Gardner, Norton, & Buchner, 1999). One study reported a significant reduction in risk of falls through a prescription medication modification program for physicians, suggesting the urgent need for further research on such a potentially important strategy (Carter et al., 2002).

More recently, in a Cochrane systematic review of 41 clinical trials of studies to reduce falls in older residents of nursing homes, long-term care facilities, and hospitals, Cameron et al. (2010) deduced that the overall effect of multifactorial interventions on fall reduction was inconclusive but was more successful when implemented by a multidisciplinary team. Such teams typically included medical and nursing staff and occasionally included rehabilitation and social work personnel. Supervised exercise and other single interventions were not effective in fall reduction in nursing homes, but these interventions and multifactorial interventions were effective in hospital and subacute settings when the stay was longer (i.e., a few weeks).

The prevalence of falls of people with AD or other dementias is well documented. The odds of sustaining an injury from a fall are greater among these older adults (the range is estimated to be between 3 and 8 times as likely) than among other older adults, and the differential increases with age (Allan, Ballard, Rowan, & Kenny, 2009; Finkelstein, Prabhu, & Chen, 2007; Rose & Maffulli, 1999; Shaw et al., 2003). The risk of falling for people with dementia is especially high shortly after admission and after transfer to other hospital units. This risk further increases with the severity of the dementia and physical impairments, but it decreases for severely demented or physically disabled patients because their activity level also substantially decreases (Bassiony et al., 2004; van Dijk, Meulenberg, van de Sande, & Habbema, 1993).

Significant fall predictors for people with AD or other dementias include diagnosis of Lewy body disorder, a history of falls or recurrent falls in the previous 12 mo, symptomatic orthostatic hypotension, abnormal gait or balance score, impaired vision, and depression score (Allan et al., 2009; Harlein, Dassen, Halfens, & Heinze, 2009; Vassallo et al., 2009). Increased levels of physical activity and younger age have been reported to be protective factors against falls for people with AD (Allan et al., 2009). Given the increased risk and incidence of falls in people with dementia and cognitive impairment, it is imperative that occupational therapy practitioners devise effective interventions to prevent falls based on a comprehensive understanding of the best available evidence.

Method for Conducting the Evidence-Based Review

This portion of the AD Evidence-Based Literature Review Project addressed the focused question, “What is the evidence for the effect of interventions to prevent falls in people with dementia?” Detailed information about the methodology for the entire AD Evidence-Based Literature Review Project can be found in Arbesman & Lieberman (2011; this issue). The focused question was developed for the American Occupational Therapy Association’s (AOTA’s) Evidence-Based Literature Review Project with input from content experts on AD and evidence-based practice. The review was limited to peer-reviewed scientific literature published after 1987. An initial review was completed by a team of doctoral students in occupational therapy at Creighton University in 2006. After the students’ graduation, René Padilla conducted additional searches in 2008 to provide needed information to update the previously published guidelines for the practice of occupational therapy for adults with AD (Corcoran, 1999). Finally, in 2010 we conducted additional searches in preparation for this article. Participants in the included studies were people with dementia. The approaches considered fit in the scope of practice of occupational therapy and included adaptation, remediation, prevention, and maintenance interventions that support engagement in occupations of self-care, work, leisure, or social participation as defined in the *Occupational Therapy Practice Framework* (2nd ed.; AOTA, 2008). Terms searched related to the population included *Alzheimer’s*, *dementia*, and *cognitive impairment*. Terms related to the interventions included *fall prevention*, *intervention*, and *safety*. Finally, terms related to the outcome included *fall reduction*, *fall prevention*, and *injury reduction*.

Results

A total of 257 titles and abstracts were reviewed, and 61 reports were read in full. Twelve studies (7 Level I, 4 Level III, and 1 Level IV) were relevant to the focused question. Each article included in the review was abstracted using an evidence table format and later summarized and appraised in a Critically Appraised Topic format. Supplemental Table 1, available online at www.ajot.ajotpress.net (navigate to this article, and click on “supplemental materials”), contains information about the objectives, design, procedures, outcomes, findings, and limitations of the studies.

The interventions reported in the studies for fall prevention for people with AD and related dementias can be divided into three broad categories: (1) exercise- and

motor-based interventions, (2) staff-directed interventions, and (3) multidisciplinary interventions. These strategies’ effectiveness was further considered when provided in single or multifaceted intervention programs. Therefore, we briefly discuss the influence that the type of program may have on the effectiveness of interventions designed to reduce risk or frequency of falls in people with AD or related dementias.

Exercise- and Motor-Based Interventions

Exercise and motor skills strategies are the most commonly used interventions for fall prevention in general (Chang et al., 2004; Gardner, Robertson, & Campbell, 2000; Sherrington et al., 2008) and have, therefore, been tested for effectiveness with people with dementia. Six studies that examined either individualized or group exercise were included in this review. As an aggregate, the results are positive but inconclusive because they were not consistent across the studies.

Four studies tested the effect of individualized exercise programs on falls (Christofolletti et al., 2008; Hauer, Becker, Lindemann, & Beyer, 2006; Mackintosh & Sheppard, 2005; Mirolsky-Scala & Kraemer, 2009). A systematic review appraised 11 RCTs that tested the effectiveness of individualized physical training on fall prevention in older adults with cognitive impairments (Hauer et al., 2006; Level I, $N = 11$). Although occupational therapy was not specifically listed in many of the studies, several included occupation-based interventions such as social interaction and training in basic ADLs. The trials had considerable heterogeneity in methodology, sample characteristics and size, intervention, and outcome and analytic measures. People with AD and related dementias were included in the samples but were not included exclusively or analyzed separately, making it difficult to ascertain the response of this specific population. Only four studies included in the review met the maximal rating for methodological quality. Although these studies did show statistically significant reductions in falls as a result of physical training, no single motor intervention stood out as clearly superior to others. Interventions used varied in type and intensity and included graded walking; strengthening and flexibility training; catching, throwing, or kicking balls; basic ADL training in seated and standing positions; balance activities; sensory stimulation; general recreational games; and aerobic or endurance activities. Long-term results either were not tested or on occasion showed deterioration. Therefore, we concluded that further research on the topic is needed to evaluate whether research consensus can be reached about these interventions.

An RCT conducted in Brazil compared the effects of two interventions (an individualized exercise program and an interdisciplinary activities program) on the balance of institutionalized people with mixed forms of dementia (Christofolletti et al., 2008; Level I, $N = 54$). Residents in the individualized exercise group focused on their own strength, balance, and cognition program under the direction of a physiotherapist. Residents in the interdisciplinary group received occupational therapist–led group arts and crafts activities that associated motor coordination exercises with cognition (e.g., painting, embroidering), group physical education sessions that included walking and exercise, and individualized physiotherapy. The control group received neither of these interventions during the study period. Participants in both intervention groups showed a statistically greater improvement in balance over the residents in the control group. However, the study did not quantify number of falls as an outcome measure but inferred an effect on falls from changes on a balance measure that can presumably be linked to fall risk prediction.

An individualized fall prevention program (strength, balance, and mobility exercises) led by physiotherapy professionals and embedded in a respite day program was not effective in preventing falls in people with dementia (Mackintosh & Sheppard, 2005; Level III, $N = 64$). In contrast to the previously discussed studies, participants in this study were community-dwelling older people with moderate to severe dementia. The respite program in which they participated 1 day per wk also included other preventive measures (e.g., foot health reviews, referrals for vision assessments). Mackintosh and Sheppard (2005) found no significant changes between baseline and 6 mo follow-up measures for the number of falls. Limitations of this study were the high dropout rate (nearly 50%), a small sample size, and inconsistent frequency of participation in the program (i.e., most participated once per wk, but when caregivers needed more respite, the older adult may have participated ≤ 3 times per wk). Mackintosh and Sheppard concluded that although the feasibility of service delivery in this model had been established, more research was needed to determine its effectiveness.

One other study reported beneficial effects of an individualized exercise program with an 85-yr-old woman with AD in a long-term care facility (Mirosky-Scala & Kraemer, 2009; Level IV, $N = 1$). Intervention was delivered by physical therapists and consisted of lower extremity and core therapeutic exercise, balance, gait, and assistive device training. Caregivers were instructed in carrying out a functional maintenance program with

focus on activities that engaged the woman's motor learning by using implicit, rather than explicit, memory. Caregivers followed the same routines used during the exercise sessions. The approach shows promise for people with explicit memory impairments, such as people with dementia, because procedural, or implicit, memory is often more preserved in this population. Further research is needed to test the intervention with a larger sample.

Two studies examined the effectiveness of group-based exercise programs for fall risk in people with AD (Ries, Drake, & Marino, 2010; Santana-Sosa, Barriopedro, López-Mojares, Pérez, & Lucia, 2008). Both studies were limited by sample size and dropout rates but showed positive results. Neither study included follow-up, so long-term effect is not known. In addition, these studies addressed physical problems considered to contribute to the risk of falling but did not include direct outcome measures to evaluate the effect on number of falls. One study, conducted in a nursing home, compared an exercise group with a control group that did not exercise (Santana-Sosa et al., 2008; Level I, $N = 16$). The intervention consisted of joint mobility, resistance, and coordination exercises accompanied by music and provided intensively (3 times per wk in 75-min sessions for 6 wk) by an exercise scientist. The other study reported on an exercise program provided by a physical therapist and student physical therapists to a community-dwelling sample (Ries et al., 2010; Level III, $N = 5$). The intervention consisted of joint mobility, resistance, and coordination exercises (two 45-min sessions each wk for 8 wk) organized into constant, blocked, massed practice. These studies' results suggest that further research is needed to test whether improvement in physical factors that may contribute to the risk of falling actually prevents falls.

Staff-Directed Interventions

Staff-directed interventions are strategies oriented toward staff rather than directly toward people with AD or other related dementias. An overarching premise of staff-directed interventions for reducing fall risk in people with dementia is that increased staff awareness of fall risk factors and of the importance of properly documenting falls, in addition to enhanced supervision or intervention provided by staff trained in fall prevention, will reduce the number of people who fall as well as the number of falls. Three studies available for review used staff-directed interventions to support this premise (Bouwen, De Lepeleire, & Buntinx, 2008; Detweiler, Kim, & Taylor, 2005; Shimada, Tiedeman, Lord, & Suzuki, 2009).

One study compared the incidence of falls in nursing home residents cared for by either nursing staff who had received multifaceted fall management training or nursing staff who had received no additional training (Bouwen et al., 2008; Level I, $N = 379$). The fall management training consisted of instruction on fall risk factors, possible environmental modifications, behaviors, and how to give reinforcing reminders. In addition, the training included instructions on how to maintain a fall diary in which details of circumstances surrounding each fall and potential preventative actions were recorded by nursing staff. Residents with dementia were included in the sample, but the effect on them was not analyzed separately. More than two-thirds of residents in each group had cognitive impairment as assessed by the Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975). Results indicated that the intervention led to an approximately 50% reduction in the number of residents who experienced at least one fall. This statistically significant result was reportedly not affected by cognitive impairment.

A second study used a similar intervention with nursing home residents with dementia who had a high incidence of falls (Detweiler et al., 2005; Level III, $N = 8$). Two certified nursing assistants received training in fall prevention, including how to safely catch a falling resident and behavior modification strategies such as diversional activities to occupy residents' time. Results showed a statistically significant decrease in the number of falls during the intervention period. However, the small sample size suggests that these results should be viewed cautiously until further research can confirm the intervention's effectiveness.

A similar single-group, pretest–posttest, repeated-measures design was used in a study that reported a statistically significant effect of staff-directed training in a long-term care facility (Shimada et al., 2009; Level III, $N = 60$). The intervention consisted of a fall prevention nursing aide to provide more directed supervision, fall reduction intervention, and environmental modifications. The total number of people who fell and falls on days when the aide was present were significantly lower than on nonintervention days. The behavioral scales used to measure outcomes also showed significant reductions in fall risk. However, fewer than half of the participants in this study had dementia, so results may not be completely applicable to the population.

Multidisciplinary Interventions

Two studies reported on the effect of multidisciplinary interventions on fall reduction (Christofolletti et al., 2008; Stenvall et al., 2007). One study compared a compre-

hensive multidisciplinary team approach with a standard approach to care (single discipline) of patients who had undergone surgical repair of femoral neck fractures (Stenvall et al., 2007; Level I, $N = 199$). The patient group that received the multidisciplinary care had overall fewer falls and fewer people who fell than did the control group. These results were consistent among the overall group as well as among the subpopulation of participants with dementia. The comprehensive team approach included increasing the number of staff present, including nurses, occupational therapists, physical therapists, a geriatrician, and a dietician. Staff education was enhanced with fall prevention strategies as well as general teamwork and rehabilitative care tactics, routine individualized care planning, active prevention and treatment of postoperative complications, home visits, and systematic nutritional analysis for participants.

A study mentioned earlier (Christofolletti et al., 2008; Level I, $N = 54$) examined the effects of multidisciplinary interventions (physiotherapy, occupational therapy, and physical education) on fall reduction in people with mixed dementia. Results of the study showed not only that balance was improved with the individualized exercise program but that the effect size was further enhanced for the group that received exercise along with group-based occupational therapy and physical education. In this study, occupational therapy included engagement of participants in arts-and-crafts activities that stimulated motor and cognitive abilities.

Multifaceted and Single-Intervention Fall Reduction Strategies

The studies reviewed thus far tested strategies that were part of single or multifaceted intervention programs (Oliver et al., 2007; Tilly & Reed, 2008). *Multifaceted programs* refers to multiple interventions provided concurrently for the purpose of reducing fall risk or incidence of falls. Two systematic reviews set out to compare the relative effectiveness of these types of programs, but their findings are ultimately inconclusive because of the heterogeneity of the interventions. Oliver et al. (2007; Level I, $N = 43$) concluded that their meta-analysis of 43 studies revealed “modest reductions in rates of falls in hospital patients with multifaceted interventions and in rates of hip fractures with hip protectors in people in long-term care facilities. However, we found insufficient evidence for any other interventions in these settings” (p. 4). Additionally, the effect of these interventions on people with dementia was difficult to discern, although Oliver et al. noted that dementia was a prevalent diagnosis among the participants of the various studies.

Tilly and Reed (2008; Level I, $N = 28$) also reviewed interventions related to falls, as well as interventions intended to reduce wandering and curtail the use of physical restraints for institutionalized people with dementia. They determined that the results of such studies were inconclusive for the same reasons mentioned by Oliver et al. (2007). They noted, however, that the effectiveness of interventions tended to be based on patients' individualized assessment and needs. Tilly and Reed concluded that multifaceted interventions showed mixed results, a finding that is congruent with those of Oliver et al.

Discussion and Implications for Practice

Most research on fall prevention interventions has been directed to people without cognitive impairment, and a paucity of research has been related to falls in people who have AD or related dementias. The 12 studies included in this review shared important limitations, including small sample sizes, heterogeneity of samples, and a focus on decreasing risks for falling while inconsistently reporting actual number of falls. In addition, follow-up was minimal, so the long-term effect of interventions is not discernable. These limitations provide opportunities for future research on the effectiveness of fall prevention strategies for people with AD. Most studies that included people with dementia were conducted in nursing homes and other institutions, so generalization of results to people living in the community can only be tentative. However, although the results should be considered preliminary, the available research does provide some guidance on potentially effective interventions:

- Individualized exercise programs may have the most positive effects on the balance of people with mixed dementia of moderate severity (Christofolletti et al., 2008; Tilly & Reed, 2008).
- Group exercise that addresses balance, range of motion, strengthening, and other biomechanical approaches has also been shown to be beneficial in improving balance, thus indirectly reducing falls (Ries et al., 2010; Santana-Sosa et al., 2008).
- Embedding physical training focused on improving gait, strength, balance, and flexibility in occupation-based intervention has some effect on reducing falls (Hauer et al., 2006; Oliver et al., 2007). Occupation-based exercise has potential to allow people with dementia to use implicit memory systems to tap into past routines (Mirolsky-Scala & Kraemer, 2009).
- No evidence exists that exercise interventions accessed occasionally as part of respite programs are effective in

reducing falls of people with AD and related dementias (Mackintosh & Sheppard, 2005).

- Close supervision and participation in activity-based intervention may be effective in reducing the number of falls of high-risk patients with dementia (Detweiler et al., 2005).
- Enhanced fall risk education for nursing staff that includes documenting any falls that take place and reflecting on possible preventative measures for each incident is likely to reduce falls of nursing home residents, most of whom have cognitive impairments (Bouwen et al., 2008).
- A dedicated staff member who serves as a fall prevention aide can significantly decrease the number of falls (Shimada et al., 2009).
- Very few increased costs are associated with implementing multidisciplinary intervention programs in inpatient settings (Stenvall et al., 2007).

Included in the educational curricula of occupational therapy practitioners is the prescription of therapeutic exercises and activities as useful preparatory methods for facilitating clients' full participation in meaningful occupations. However, only one of the exercise- or motor-based intervention studies included in this review specifically included occupational therapy. Occupational therapy practitioners should capitalize on the preliminary evidence that exercise-based fall prevention and reduction strategies that include occupation-based activities show promise for people with AD and should contribute to outcome studies that would strengthen this evidence.

Any staff-directed fall prevention program should include mechanisms for referral to occupational therapy so an individualized fall prevention program embedded in daily routines can be developed. Occupational therapy practitioners are well suited to develop and supervise programs for nursing staff education grounded in occupational therapy theories that emphasize the dynamic interplay among person, environment or context, and occupation (AOTA, 2008). Staff-directed approaches may initially require greater resource allocation to increase the intensity of patient supervision, but a cost-benefit analysis may reveal overall cost savings by preventing falls. Additionally, staff-directed approaches may prove to be a relatively inexpensive fall prevention measure if embedded into new staff orientation.

Occupational therapy practitioners should participate in the design of comprehensive programs for home, community, and long-term care settings so that such settings include opportunities for people to maintain engagement and participation in activities. This participation is particularly important in postoperative intervention

programs for people with AD and related dementias during inpatient stays after femoral neck fractures, when multi-disciplinary teams are needed to prevent further falls. Occupational therapy practitioners can provide training in basic ADL routines and environmental modification to reduce fall risk factors. Although evidence is available only regarding effectiveness of multifaceted interventions in reducing falls in hospital settings, such strategies may also be effective in community settings.

Conclusions

Few studies on falls included interventions provided by occupational therapy practitioners, but when they did, effects were invariably reported as positive. Results of this systematic review initially validate the importance of interventions embedded in usual occupational routines of people with AD and related dementias. Therefore, occupational therapy practitioners are well positioned to contribute to the production of needed research to further determine the best approaches to prevent falls. Occupational therapy practitioners have the professional responsibility to remain abreast of the best available research evidence to provide the highest quality and most cost-effective care to the people they serve. In the case of people with AD and related dementias, quality care includes facilitating their safety and well-being because their risk of falling is higher than that of people who are cognitively intact. ▲

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