
Effect of Home Modification Interventions on the Participation of Community-Dwelling Adults With Health Conditions: A Systematic Review

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OBJECTIVE. This systematic review investigated the role of home modification interventions to improve participation outcomes for community-living adults and older adults.

METHOD. Thirty-six articles met the inclusion criteria. The majority of the studies investigated older adult populations and used occupational therapists as interventionists.

RESULTS. Strong evidence was found for home modification interventions to improve function for people with a variety of health conditions and for both single and multicomponent interventions that included home modifications to reduce the rate and risk of falls among older adults. Moderate evidence was found for improved caregiving for people with dementia.

CONCLUSION. Comprehensive, higher intensity interventions demonstrated greater efficacy to improve occupational performance. Emerging evidence was also found for the role of occupational therapy in providing effective home modification interventions. Implications for occupational therapy practice, education, and research are discussed.

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Current estimates indicate that 9.4 million community-dwelling adults in the United States have difficulty completing at least one activity of daily living (ADL) and 12 million report dependence in at least one ADL or instrumental activity of daily living (IADL; Brault, 2012). For many, a mismatch between personal abilities and the home environment (e.g., the presence of barriers impeding performance) results in ADL and IADL disability (Wahl, Fänge, Oswald, Gitlin, & Iwarsson, 2009; World Health Organization [WHO], 2011). If people with functional limitations do not have adequate environmental supports in their home, personal care assistance or a move to an institution may become necessary, creating an increased financial burden for both families and the health care system (Fried, Bradley, Williams, & Tinetti, 2001). With the increase in the aging population and prevalence of chronic health conditions, the number of people affected by environmental barriers is expected to rise (WHO, 2011), making safety and participation in ADLs and IADLs a growing public health concern.

Home modifications are a common compensatory strategy used by occupational therapy practitioners to reduce environmental barriers and improve the occupational performance of clients with functional limitations. Previous systematic reviews that have included home modification interventions have clarified the important role these modifications play in reducing fall risk and improving functional outcomes. Research has found the strongest evidence for fall reduction when interventions were targeted at older adults with a high fall risk

(Chase, Mann, Wasek, & Arbesman, 2012; Clemson, Mackenzie, Ballinger, Close, & Cumming, 2008; Costello & Edelstein, 2008; Lord, Menz, & Sherrington, 2006; Tse, 2005). Wahl et al. (2009) investigated the effects of home modifications on disability-related outcomes and found that home modification interventions improve functional outcomes.

The evidence that home modifications can improve the performance and safety of people with functional limitations is growing. However, previous reviews have focused on older adults and a specific outcome and have lacked evidence for dementia-related disorders (Wahl et al., 2009). Previous reviews indicate that the intensity of the intervention and target population should be important considerations when determining the efficacy of home modification interventions (Clemson et al., 2008; Wahl et al., 2009). Thus, the purpose of this systematic review was to update previous reviews and explore the evidence for the effectiveness of home modification interventions within the scope of occupational therapy practice for adults and older adults to support *home and community participation*, which is broadly defined as involvement in a life situation (WHO, 2011). In addition to updating the evidence, we conducted a thematic analysis to identify additional outcomes and populations of interest to occupational therapy.

Method

This systematic review was initiated and supported by the American Occupational Therapy Association (AOTA) as part of its Evidence-Based Practice Project to update the practice guidelines on this topic. One focused question served as the basis for the review: “What is the evidence for the effectiveness of home modification interventions within the scope of occupational therapy for adults and older adults to participate in areas of occupation in the home and community?” This question was evaluated by the review authors, an advisory group of content experts in the field, AOTA staff, and the methodology consultant to the Evidence-Based Practice Project.

Articles were included if they were published in a peer-reviewed journal, studied community-dwelling participants ages 18 yr and older with health conditions affecting performance of daily activities, included a home modification intervention within the scope of occupational therapy practice, and were published in an English-language journal. Studies classified as Level I, II, or III evidence (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996) were included. Exclusion criteria included publication before 1990 or classification as Level IV or V evidence

(Sackett et al., 1996). Presentations, conference proceedings, dissertations, and theses were also excluded. Articles published from 1990 through July 2011 were identified using the following databases: Medline, PsycINFO, CINAHL, AgeLine, Scopus, OTseeker, and the Cochrane Database of Systematic Reviews. An updated search was completed for articles published from July 2011 through January 2014. In addition, reference lists from selected articles (Chase et al., 2012; Clemson et al., 2008; Wahl et al., 2009) and journals were hand searched for relevant articles. Search terms for the review are listed in Figure 1. The search was completed by a medical librarian with experience in completing systematic reviews.

The AOTA methodology consultant identified potential articles after reviewing titles and abstracts, and duplicate and irrelevant articles were removed. Articles were managed in Endnote software. A group of seven graduate students was trained to review articles. Three reviewers evaluated each abstract for inclusion criteria using an abstraction form. Discrepancies were resolved through discussion, with the first author making the final determination. Full-text articles were retrieved, and two reviewers determined whether the article met the eligibility criteria. A third reviewer was consulted in the case of any discrepancies. Next, articles were systematically reviewed and evaluated for quality and bias using a critical appraisal worksheet. Elements extracted included the clinical bottom line; research objectives; study design; study limitations; intervention type, intensity, and quality; professional training of the person delivering the service; evidence of client centeredness; measures and outcomes; results; and analytic methods.

Accessible design Built environment Environmental design Environmental barriers Environmental hazard Environmental modification Environmental supports Home adaptation Home assessment Home hazards Home modification Home office Home repair Home safety Home safety equipment Housing adaptation Housing for the elderly Person–environment fit Universal design
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Figure 1. Search terms.

Note. Limited to adult and older adults; developed by AOTA staff and validated with expert panel.

The strength of the evidence is based on the U.S. Preventive Services Task Force (2012) guidelines. The designation of *strong evidence* includes consistent results from well-conducted studies, usually at least 2 randomized controlled trials (RCTs). A designation of *moderate evidence* may be made on the basis of 1 RCT or 2 or more studies with lower levels of evidence. In addition, some inconsistency of findings across individual studies might preclude a classification of strong evidence. The designation of *limited evidence* may be based on few studies, flaws in the available studies, and some inconsistency in the findings across individual studies. A designation of *mixed evidence* indicates the findings were inconsistent across studies in a given category. A designation of *insufficient evidence* indicates that the number and quality of studies were too limited to make any clear classification. An evidence table describing the design, intervention, outcome measures, and results of the studies was prepared and reviewed by AOTA staff and the project consultant (see

Supplemental Table 1, available online at <http://otjournal.net>; navigate to this article, and click on “Supplemental”).

Results

From the initial 6,762 identified articles, 180 titles and abstracts were reviewed for relevance. Of those articles, 60 full-text articles were reviewed for eligibility, and 35 studies met the inclusion criteria. The updated search identified an additional 9 articles; of these, 1 article met the inclusion criteria, resulting in a total of 36 articles (Figure 2). Twenty-five articles provided Level I evidence, 3 provided Level II evidence, and 8 provided Level III evidence. Thematic analysis revealed three primary outcomes: functional performance, improved caregiving outcomes, and fall risk reduction (Figure 3). No articles addressed community participation. Within each of these areas, articles were further grouped into subthemes for analysis and synthesis.

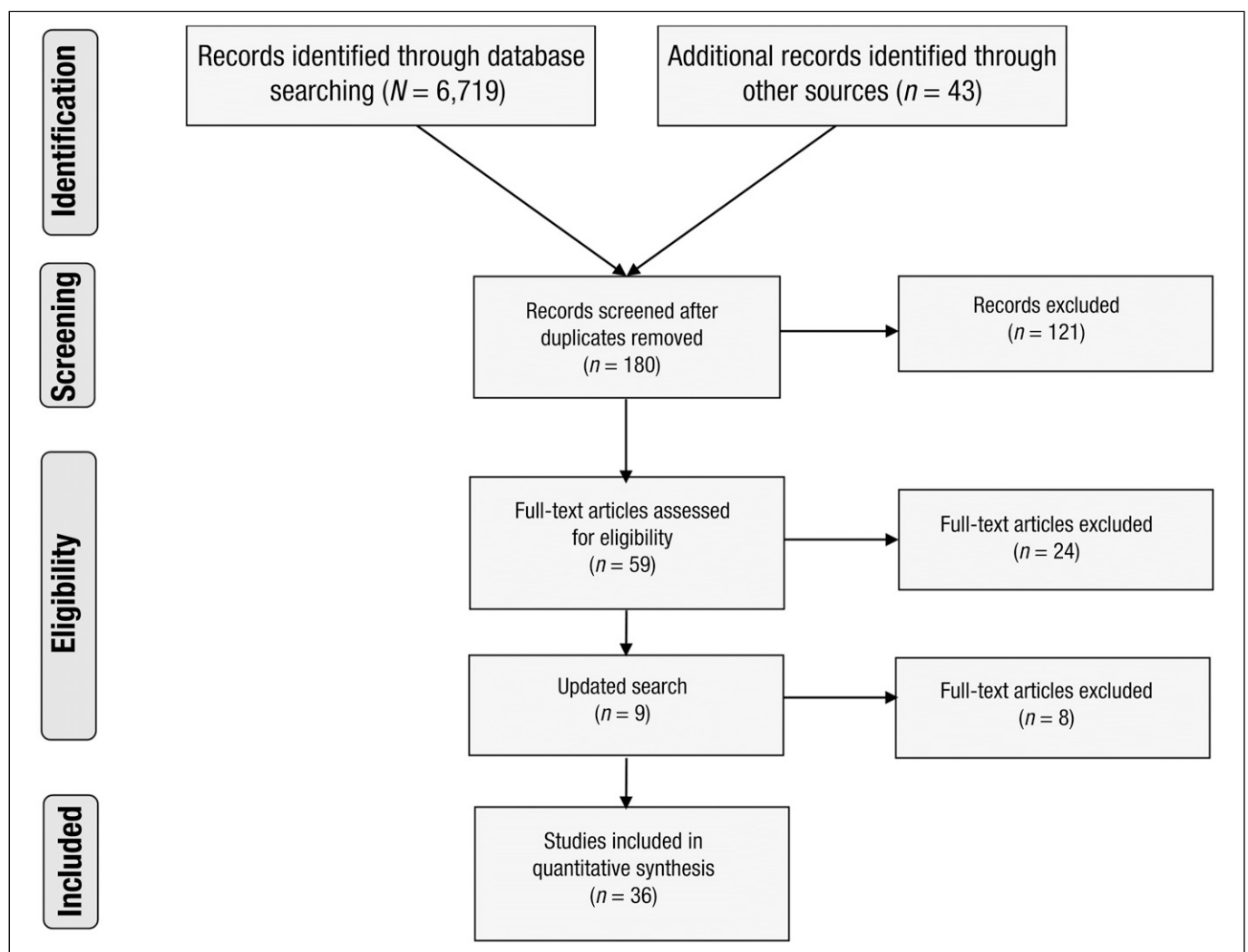


Figure 2. Flow diagram of included studies.

Functional performance
Frail older adults
Functional impairment
Postoperative hip repair
Low vision
Schizophrenia
Caregiving
Caregiving and function for people with dementia
Fall risk reduction
Multicomponent interventions
Single-component interventions

Figure 3. Primary outcomes and subtheme.

Risk of Bias

The studies did present with a risk for bias (Table 1). For example, none of the studies blinded participants to the purpose of the study (performance bias), which is common for behavioral interventions such as home modifications, in which sham treatment is difficult to provide. Although many of the studies (in particular, the fall prevention studies) were randomized, there was generally a lack of information about allocation concealment. The risk of bias for selective reporting was low; authors reported the primary outcomes that were described in the articles. However, only 2 studies were prospectively registered in a clinical trials registry. In the fall prevention studies, data for the primary outcome were self-reported and could be considered at high risk for detection bias. However, we did not consider the self-report measures to be high risk because fall diaries collected at least once per month are considered the gold standard in fall prevention studies (Lamb, Jørstad-Stein, Hauer, & Becker, 2005). The nonrandomized trials were graded as having a high risk of selection bias, performance bias, and detection bias.

Home Modifications to Improve Functional Performance

Strong evidence was found that home modification interventions are an effective treatment to improve function for people with a variety of conditions.

Frail Older Adults. Seven articles investigated home modification interventions for frail older adults: 3 Level I and 3 Level III articles. Gitlin et al. (2006; Level I) evaluated a multicomponent intervention including home modifications, education, and balance and strength training provided by occupational and physical therapists. The intervention group reported significantly less difficulty completing ADLs and IADLs, significantly less fear of falling, greater self-efficacy in managing daily activities, and fewer home hazards than the control group. Another Level I study installed smart home technology after home assessments by an occupational

therapist or trained nurse. At 2-yr follow-up, the intervention group demonstrated significantly higher cognitive function and rate of independent living while maintaining functional status. The control group experienced a significant decline in function (Tomita, Mann, Stanton, Tomita, & Sundar, 2007).

Stark and colleagues (Stark, 2004; Stark, Landsbaum, Palmer, Somerville, & Morris, 2009; both Level III) provided individualized home modifications and training by an occupational therapist. Participants had significant improvements in performance and satisfaction with daily activities after the intervention (Stark, 2004; Stark et al., 2009). An adherence rate of 80% was reported, and perception of daily activity performance was maintained at 2 yr (Stark et al., 2009). Gitlin, Miller, and Boyce (1999; Level III) investigated a bathroom modification intervention. An occupational therapist observed bathing and toileting tasks, recommended modifications, and provided training. Significant improvements occurred in bathing, ADL performance, and transfers. Participants used 84% of equipment provided.

One Level I study that delivered a less intensive intervention also provided positive evidence for the reduction in functional decline over time. Physically frail older adults received assistive technology and home modifications from an occupational therapist, assisted by a nurse and a home modification technician. The treatment group demonstrated significantly less functional decline than the control group at 18 mo. The control group had significantly higher expenditures for institutional care and nurse and case manager visits (Mann, Ottenbacher, Fraas, Tomita, & Granger, 1999). These studies provide strong evidence for home modification interventions to improve functional outcomes for frail older adults.

Functional Impairment. Five studies contributed limited evidence that home modification improves the function of adults aging with functional impairment. Wilson, Mitchell, Kemp, Adkins, and Mann (2009; Level I) studied people aging with a disability, comparing assistive technology, home and task modifications, and training with standard care. Although both groups demonstrated functional decline and an increase in caregiver hours over time, the treatment group demonstrated a slower decline over 2 yr. The intervention group reported fewer caregiver hours than the control group at both 12 and 24 mo, but the difference between groups was not statistically significant. In a study by Stanton et al. (2011; Level I), low-income older adults with disabilities received a multicomponent behavior and home repair intervention from occupational therapists, nurses, and handymen. The intervention demonstrated moderate to strong effect sizes

Table 1. Risk of Bias by Study

Citation	Selection Bias		Performance Bias: Blinding of Participants and Personnel	Blinding of Outcome Assessment (Detection Bias; Patient-Reported Outcomes)	Incomplete Outcome Data (Attrition Bias; Short or Long Term)	Reporting Bias: Selective Reporting
	Random Sequence Generation	Allocation Concealment				
Brunnström, Sörensen, Alsterstad, & Sjöstrand (2004)	+	?	?	?	+	+
Campbell et al. (2005)	+	+	-	+	+	+
Clemson et al. (2004)	+	+	-	+	+	+
Close et al. (1999)	+	+	?	+	+	+
Cumming et al. (1999)	+	+	-	+	+	+
Davison, Bond, Dawson, Steen, & Kenny (2005)	+	+	-	+	+	+
Dooley and Hinojosa (2004)	?	?	-	?	+	+
Fänge and Iwarsson (2005)	-	-	-	-	?	+
Gitlin, Miller, & Boyce (1999)	-	-	-	-	-	+
Gitlin, Corcoran, Winter, Boyce, & Hauck (2001)	?	?	-	?	-	-
Gitlin et al. (2003)	+	+	-	+	+	+
Gitlin et al. (2006)	+	+	-	+	+	+
Graff, Vermooij-Dassen, Hoefnagels, Dekker, & de Witte (2003)	-	-	-	+	+	+
Graff et al. (2006)	+	+	-	+	+	+
Hagsten, Svensson, & Gardulf (2004)	+	+	-	+	+	+
Hendriks et al. (2008)	+	+	-	+	?	?
Huang and Acton (2004)	?	?	-	-	-	+
La Grow, Robertson, Campbell, Clarke, & Kerse (2006)	+	+	-	+	+	+
Lin, Wolf, Hwang, Gong, & Chen (2007)	?	?	-	-	+	-
Mann, Ottenbacher, Fraas, Tomita, & Granger (1999)	+	?	-	-	-	+
Nikolaus and Bach (2003)	+	+	-	+	+	+
Pardessus et al. (2002)	+	-	-	-	?	+
Petersson et al. (2008)	-	-	-	-	+	+
Petersson et al. (2009)	-	-	-	-	+	+
Pighills, Torgerson, Sheldon, Drummond, & Bland (2011)	+	+	?	+	+	+
Plautz, Beck, Selmar, & Radetsky (1996)	-	-	-	-	?	+
Poustrup & Jeune (2000)	?	?	?	+	?	+
Stark (2004)	-	-	-	-	?	+
Stark, Landsbaum, Palmer, Somerville, & Morris (2009)	-	-	-	-	?	+
Szanton et al. (2011)	?	?	?	+	+	+
Tinetti et al. (1999)	?	?	?	+	+	+
Tomita, Mann, Stanton, Tomita, & Sundar (2007)	?	?	-	?	+	+
van Haastregt et al. (2000)	+	?	-	-	+	+
Velligan et al. (2008)	?	?	?	+	+	+
Velligan et al. (2009)	?	?	?	+	+	+
Wilson, Mitchell, Kemp, Adkins, & Mann (2009)	+	?	-	+	+	+

Note. Categories for risk of bias: + = low risk of bias; ? = unclear risk of bias; - = high risk of bias.

for differences in mean change between the intervention and control groups for function and quality of life.

Three studies investigated home modifications as part of a housing adaptation program in which people with disabilities received modifications based on an occupational therapist's assessment through a government program. One Level III study found no significant change in ADL scores after home modifications, although a decrease in dependence in bathing occurred over time (Fänge & Iwarsson, 2005). Petersson, Lilja, Hammel, and Kottorp (2008; Level II) reported a significant improvement in self-rated daily activity performance compared with a wait-list control group. Participants who received home modifications also experienced fewer difficulties performing daily activities (Petersson, Kottorp, Bergström, & Lilja, 2009 [Level II]; Petersson et al., 2008).

Postoperative Hip Repair. Two Level I articles provided mixed evidence for home modifications after hip repair. Hagsten, Svensson, and Gardulf (2004) compared the efficacy of a pre-discharge home visit to identify home modifications and tailored ADL training by an occupational therapist with that of usual care. At 2-mo follow-up, both groups had regained ADL and IADL function, although a portion of the control group did receive home modifications (Hagsten et al., 2004). Tinetti et al. (1999) provided in-home therapy by a rehabilitation nurse that included environmental and task modifications, psychological interventions, caregiver education, and referrals. Both groups reported independence in self-care at 6 and 12 mo, with no significant difference in functional outcomes between groups (Tinetti et al., 1999).

Low Vision. One Level I study contributed limited evidence for home modifications for people with low vision. All participants received standard lighting adaptations. The intervention group received additional task lighting in the living room. The intervention group reported a significant improvement in quality of life; the control group did not (Brunnström, Sörensen, Alsterstad, & Sjöstrand, 2004).

Schizophrenia. One Level I study (reported in 2 articles) provided moderate evidence for the use of intensive, tailored home modification interventions for community-dwelling people with schizophrenia (Velligan et al., 2008, 2009). In a comparison of tailored environmental supports in the home, generic environmental resources provided in a clinic, and usual care, the tailored and generic environmental resource groups demonstrated improvements in social and occupational functioning compared with usual care at 3 mo (Velligan et al., 2009). At 9 mo, the tailored group demonstrated the most significant improvements, although treatment gains declined as sessions were reduced (Velligan et al., 2008). Participants who demonstrated

greater adherence were more likely to improve target behaviors (Velligan et al., 2009).

Caregiving

Moderate evidence was found for home modification interventions to improve caregiving for people with dementia. Four studies addressed caregiver and care recipient outcomes after home modification interventions.

Two Level I studies investigated the effects of environmental modification interventions based on a competence-press framework, including caregiver education on dementia and the impact of the environment on function, implementation of home modification strategies, and generalization of strategies provided by an occupational therapist (Gitlin, Corcoran, Winter, Boyce, & Hauck, 2001; Gitlin et al., 2003). In 1 study, caregivers in the intervention group reported reduced upset with behaviors, female caregivers experienced increased self-efficacy in managing behaviors, and female and racial/ethnic minority caregivers had increased self-efficacy in managing functional dependency. Caregivers in the intervention group reported fewer declines in the care recipient's IADL performance (Gitlin et al., 2001). Gitlin et al. (2003) reported that caregivers who received the intervention reported decreased feelings of burden, fewer days of help from family, and less upset with memory-related problems than the control group. No statistically significant treatment effects occurred for care recipient functioning.

Dooley and Hinojosa (2004; Level I) compared caregivers and care recipients who received tailored written recommendations for environmental modifications, caregiver approaches, and community resources with a control group. Caregivers followed a mean of 65% of the five most important strategies and reported significantly lower levels of burden than the control group. Graff et al. (2003, 2006) trained people with dementia in the use of compensatory and environmental strategies and caregivers in problem-solving, coping, and supervision strategies. Significant improvement was demonstrated in caregiver sense of competence and care recipient motor and process skills in both the pilot study (Graff et al., 2003; Level III) and the subsequent RCT (Graff et al., 2006; Level I).

Fall Risk Reduction

Multicomponent Interventions. Strong evidence was found for home modifications provided by occupational therapists as part of a multicomponent intervention to reduce falls. Interventions were considered multicomponent if they included home modifications with at least one additional fall prevention intervention. Three Level I

articles investigated older adults presenting to emergency departments with a fall-related injury. Davison, Bond, Dawson, Steen, and Kenny (2005) provided medical, physical therapy, and occupational therapy interventions, including a home hazard assessment and plan for barrier removal, resulting in a 36% reduction in falls in the intervention group. Close et al. (1999) provided medical and occupational therapy interventions, including hazard identification with minor home repair, adaptive equipment, and referral for extensive modifications. The intervention group had a lower risk and rate of falling at 12 mo. Hendriks et al. (2008) provided medical and in-home assessment, completed by an occupational therapist, along with written recommendations and referrals. Adherence to the recommendations was 75%. They found no significant difference in falls or daily function in the intervention group compared with the control group. Participants age 80 yr and older in the intervention group demonstrated significant functional improvements compared with the control group.

Clemson et al. (2004) completed a Level I study that provided a self-management educational program including home hazard assessment and recommendations. In a sample of community-dwelling older adults who had a previous fall or who were worried about falling, the treatment group reported a 31% reduction in falls. Adherence was modest, with 70% of participants fulfilling 50% of the recommendations.

Campbell et al. (2005; Level I) and La Grow, Robertson, Campbell, Clarke, and Kerse (2006; Level I) reported on a single trial that compared groups receiving a home safety program, an exercise program and vitamin D supplements, home safety and exercise programs, or a control condition for older adults with severe visual impairments. The home safety program included a checklist and plan to remove or reduce barriers. Participants who received the home safety program had fewer falls (Campbell et al., 2005), and hazard- and non-hazard-related falls were reduced among participants in the home safety program only compared with the control condition (La Grow et al., 2006).

Four studies investigated multicomponent interventions, including home modifications without occupational therapists. Professionals providing environmental interventions included nurses, home health workers, and general practitioners. Tinetti et al. (1999; Level I) provided physical and functional therapy after hip fracture. No significant difference was seen in falls between groups. Van Haastregt et al. (2000; Level I) found no reduction in falls for people with mobility impairments or a history of recent falls after medical, environmental, and behav-

ioral screenings with recommendations. Poulstrup and Jeune (2000; Level II) provided all adults older than age 65 yr with written and verbal information on risk factors of falling and provided home visits to adults older than age 70 yr or who had received help from home health workers. No significant reduction in falls between groups was found. Huang and Acton (2004) completed a Level III study in which both the intervention and the control groups received a home visit and standardized brochures about medication safety and fall hazards. The intervention group also received individualized brochures and instruction. At 2 mo, a similar reduction in falls was reported for both groups.

Single-Component Interventions. Studies were considered single component if environmental risk factors were the only target of the intervention. The intensity of interventions (which ranged from a list of recommendations to procurement of and training to use the modifications) varied considerably. Five Level I articles and 1 Level III study provided strong evidence for the efficacy of home modification interventions that include occupational therapists.

Cumming et al. (1999; Level I) investigated the efficacy of a comprehensive intervention provided by an occupational therapist that included assessment, assistance with procuring modifications, and follow-up visits. At 1 yr, approximately 50% of recommendations were completed. Participants with a history of falls within the preceding year experienced a significant reduction in falls. Nikolaus and Bach (2003; Level I) used a geriatric assessment team, including an occupational therapist, to identify home hazards, prescribe aids, and facilitate home modifications for older adults who showed functional decline. A significant reduction in falls occurred for participants who completed at least one recommended modification (75.7% of participants). Pardessus et al. (2002; Level I) completed an RCT that provided one home visit for older adults hospitalized for a fall. A physical medicine and rehabilitation doctor and ergo-therapist completed the visit; recommendations for hazard removal were made and carried out, if possible, during the visit. No additional training or follow-up was completed. No significant difference in rate of falls between groups was reported.

Two studies used health professionals other than occupational therapists to investigate older adults requiring medical attention after a fall. A Level I study compared exercise, home hazard removal, and control groups (Lin, Wolf, Hwang, Gong, & Chen, 2007). Home hazard removal was provided by public health workers and included a tailored list of recommendations and 14

standard modifications. No between-groups difference in fall risk was found. Pighills, Torgerson, Sheldon, Drummond, and Bland (2011; Level I) compared interventions delivered by occupational therapists or domiciliary workers (both trained to conduct a standardized assessment) and usual care. The occupational therapy group received more recommendations per visit, had a higher adherence rate, and fell significantly less than the control group. The domiciliary group did not show a significant difference in fall rates from the control group. A Level III study investigated the efficacy of minor home safety repairs and education by outreach workers to reduce falls in older adults at high risk for falling. At 6 mo, the rate of falls was reduced by 59% (Plautz et al., 1996).

Discussion

The results of this review provide occupational therapists with the latest evidence to guide practice in home modifications. This systematic review identified three outcome areas—(1) improved functional performance, (2) reduced risk of falls, and (3) reduced demands on caregivers—that address key areas that allow adults who are aging or living with disabilities to remain in the community. Use of home modifications resulted in improved function, increased ability to provide care, and decreased falls for people with a broad range of impairments. Similar to the findings of Clemson et al. (2008), this review found an increase in effectiveness of home modification interventions, which include an increased intensity of home modification assessment, intervention, follow-up training, and professional expertise in evaluating the person and environment. Comprehensive home modification interventions that include (1) assessment of a person's abilities, (2) assessment of the home environment and occupational goals, (3) an intervention plan to remediate barriers, (4) implementation of or support for the implementation of the plan, and (5) training of the client or caregiver to complete his or her daily activities using environmental support are more effective than less comprehensive interventions. Data have suggested that occupational therapists are more effective in delivering home modification interventions than other professions, but further evidence is needed.

This review strengthens previous reviews of the literature by providing up-to-date evidence for home modification interventions for fall prevention and occupational performance for adults living with disabilities. In agreement with previous studies, this review found that home modifications are effective in reducing falls among high-risk older adults (Chase et al., 2012; Clemson et al., 2008; Costello & Edelstein, 2008; Lord et al., 2006; Tse,

2005) and improving function for adults with disabilities (Wahl et al., 2009). Because of the broad scope of home modification interventions, this review assessed the efficacy of home modifications by grouping studies by target outcome and health condition. Through this process, caregiving outcomes were identified as an emerging area of evidence for home modification interventions. In addition, this review was limited to studies that assessed interventions. Therefore, this review provides practitioners with the most recent evidence-based practice in the area of environmental modifications with regard to specific outcomes and populations.

The results should be interpreted in light of the limitations of the included articles. For example, small sample size, variation in the intervention and quality of the intervention, a broad range of participants, lack of blinding, a high rate of attrition, limited details on the interventions, and lack of consistency of primary endpoints and follow-up time make comparison between studies difficult. The variations in intensity, types of modifications, and assessments across studies make comparing results difficult. Standards for home modification intervention research, such as follow-up period, measurement of environment and outcomes, reporting of results, and operational definitions of home modification interventions to facilitate standardized and comparable outcomes, need to be developed. Moreover, the use of multicomponent interventions makes it difficult to separate out the role of home modifications. Although this review included home modifications to support both home and community participation, evidence addressing the impact of modifications on community participation was lacking. The risk of bias is an additional concern when evaluating the results of this review. Overall, the risk of performance bias was high, information on allocation concealment was lacking, and the risk for selective reporting was low.

Implications for Occupational Therapy Education, Research, and Practice

- Occupational therapy education should include comprehensive assessment of person and environmental factors that influence occupational performance, including task analysis to identify environmental barriers and supports.
- Education should also include training older adults and their caregivers to safely use environmental supports and reestablish habits and routines.
- Areas of future study include investigation of effective intervention intensity and dose, factors affecting adherence, the role of home modifications in multicomponent

interventions, and the efficacy of home modifications in additional populations.

- Caregiving research was limited to dementia caregiving and would benefit from expanding to caregivers of people with other health conditions.
- Research should be conducted across the continuum of care to guide future health care practice.
- Occupational therapy practitioners should provide assessment of and recommendations to clients and caregivers, along with adequate training, education, and follow-up for effective home modification interventions to improve participation. ▲

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Supplemental Table 1. Evidence for the Effectiveness of Home Modification Interventions on Participation of Community-Dwelling Adults and Older Adults

Author/Year	Level of Evidence/Study Design/Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Brunnström, Sörensen, Alsterstad, & Sjöstrand (2004) https://doi.org/10.1111/j.1475-1313.2004.00192.x	Level I RCT <i>N</i> = 46 adults with low vision (<i>M</i> age = 76 yr, range = 20–90). Lighting intervention group, <i>n</i> = 24. Control group, <i>n</i> = 22. <i>Inclusion criteria</i> Individuals selected for adjustment of domestic lighting from a low-vision clinic.	<i>Intervention</i> Lighting adaptations in the kitchen, bathroom, and hallway and improved task lighting in the reading area of the living room. <i>Control</i> Lighting adaptations in the kitchen, bathroom, and hallway.	<ul style="list-style-type: none"> • Interview about performance of ADLs and QOL 	QOL for the intervention group improved significantly; the control group had no change in QOL or well-being. The effect of the basic lighting adaptation in kitchen, hall, and bathroom on ADLs for both groups was significant for tasks carried out on the kitchen work surface.
Campbell et al. (2005) https://doi.org/10.1136/bmj.38601.447731.55	Level I RCT <i>N</i> = 391 older adults age 75 yr and older with low vision (<i>M</i> age = 83.6 yr). Home safety and modifications only, <i>n</i> = 100 (<i>M</i> age = 83.1 yr). Otago (home-based) exercise program only, <i>n</i> = 97 (<i>M</i> age = 83.4 yr). Both home modifications and Otago exercise program, <i>n</i> = 98 (<i>M</i> age = 83.8 yr). Social visit control, <i>n</i> = 96 (<i>M</i> age = 84.0 yr).	<i>Intervention</i> <i>Home safety and modifications only:</i> Home safety program included a home safety checklist with referral and recommendations to reduce home hazards by an OT. <i>Otago exercise program:</i> The exercise program included a modified exercise program with vitamin D supplementation. <i>Control</i> Two 60-min social visits in the home.	<ul style="list-style-type: none"> • Falls and injuries (self-report) 	90% of the home safety group reported complying partially or completely with ≥1 recommendation. Home safety program participants had 41% fewer falls than those who did not receive this program. No significant difference was found in reduction in falls at home compared with falls away from the home. The home safety program cost \$432 per fall prevented.
Clemson et al. (2004) https://doi.org/10.1111/j.1532-5415.2004.52411.x	Level I RCT <i>N</i> = 310 community residents age 70 yr and older with a fall history in the previous 12 mo or who were concerned about falling. Stepping On program, <i>n</i> = 157 (74% women; <i>M</i> age = 78.31 yr). Control group, <i>n</i> = 153 (74% women; <i>M</i> age 78.47 yr).	<i>Intervention</i> Stepping On, a multifaceted community-based program led by an OT using small-group learning with follow-up home visit and booster session. Session topics included risk appraisal, exercises, home hazards, community safety and footwear, vision and falls, medication management, and planning ahead. <i>Control</i>	<ul style="list-style-type: none"> • Falls (self-report) 	Intervention group had a 31% reduction in falls. 70% of participants adhered to ≥50% of home modification recommendations.

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Supplemental Table 1. Evidence for the Effectiveness of Home Modification Interventions on Participation of Community-Dwelling Adults and Older Adults (cont.)

Author/Year	Level of Evidence/Study Design/Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Close et al. (1999) https://doi.org/10.1016/S0140-6736(98)06119-4	Level I RCT <i>N</i> = 397 adults age 65 yr or older, living in the community, who presented to the emergency department with a fall (<i>M</i> age = 78.2 yr). Medical and occupational therapy assessment, <i>n</i> = 184 (<i>M</i> age = 78.9 yr). Control group, <i>n</i> = 213 (<i>M</i> age = 77.3 yr).	<i>Intervention</i> Treatment included OT assessment in the home to identify and remove environmental hazards, safety education, minor home repair, adapted equipment, and referral for extensive modifications.	<ul style="list-style-type: none"> Falls (self-report via mailed follow-up) at 8 and 12 mo Barthel Index for ADL/IADL performance 	<p>Risk of falling and rate of falling were lower in the intervention group than the control group in the 12-mo follow-up period.</p> <p>Both groups experienced a reduction in Barthel Index scores over time, but the intervention group had less of a decline.</p>
Cumming et al. (1999) https://doi.org/10.1111/j.1532-5415.1999.tb01556.x	Level I RCT <i>N</i> = 530 community-dwelling adults age 65 yr and older (<i>M</i> age = 77 yr). OT, <i>n</i> = 264 (<i>M</i> age = 76.4 yr). Control group, <i>n</i> = 266 (<i>M</i> age = 77.2 yr).	<i>Intervention</i> Home visit conducted by an OT. Treatment included comprehensive assessment of person and home and facilitation of home hazard removal. <i>Control</i> No home visit.	<ul style="list-style-type: none"> Falls (self-report) 	<p>Approximately 50% of recommended home modifications were in place at 12 mo.</p> <p>The intervention was effective only among participants (<i>n</i> = 206) who reported having had ≥1 falls during the yr before recruitment into the study.</p>
Davison, Bond, Dawson, Steen, & Kenny (2005) https://doi.org/10.1093/ageing/af053	Level I RCT <i>N</i> = 313 cognitively intact adults age 65 yr or older who presented to Accident & Emergency with a fall or fall-related injury and had 1 additional fall in the preceding yr. Intervention group, <i>n</i> = 159 (<i>M</i> age = 77 yr). Control group, <i>n</i> = 154 (<i>M</i> age = 77 yr).	<i>Intervention</i> Multifactorial, multidisciplinary intervention targeting fall risk factors, including medical, PT, and OT assessment and intervention. OT provided a home hazard assessment and plan for removal. <i>Control</i> Usual care.	<ul style="list-style-type: none"> Falls and fear of falling (fall diary) Injury rates, Fail-related hospital admissions Mortality 	<p>The intervention group had 36% fewer falls.</p> <p>No difference was found between the treatment and intervention groups in the risk of falls or the number of fall-related hospital admissions.</p>
Dooley & Hinojosa (2004) https://doi.org/10.5014/ajot.58.5.561	Level III Pretest–posttest <i>N</i> = 40 community-dwelling people in the mild to moderate stages of AD (<i>M</i> age = 77.08 yr) and their caregivers (80% women).	<i>Intervention</i> In-home assessment and a treatment plan including education and environmental adaptation were provided to the person with AD and his or her caregiver. <i>Control</i> The control group was mailed a written treatment plan (the intervention) at the completion of study follow-up.	<ul style="list-style-type: none"> Caregiver-reported scores on the Affect and Activity Limitation–Alzheimer’s Disease Assessment and Zarit Burden Interview 	<p>A significant main effect was found for caregiver burden, positive affect, activity frequency, and self-care status of the treatment group.</p> <p>Caregivers followed 65.1% of the strategies recommended by the OT either “sometimes” or “often.”</p>

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Supplemental Table 1. Evidence for the Effectiveness of Home Modification Interventions on Participation of Community-Dwelling Adults and Older Adults (cont.)

Author/Year	Level of Evidence/Study Design/Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Fänge & Iwarsson (2005) https://doi.org/10.5014/ajot.59.3.296	Level III Longitudinal, before and after $N = 131$ community-dwelling adults age 18 yr and older with ≥ 1 functional limitation who were being considered for housing adaptation grants (88 women, 43 men; M age = 71 yr, range = 24–93).	<i>Intervention</i> Housing adaptation grants administered by community-based OTs. Participants were assessed before, 2–3 mo after, and 8–9 mo after housing modification.	<ul style="list-style-type: none"> • ADL Staircase, Revised Version • Usability in My Home Instrument 	No significant change occurred in total ADL scores at any time point relative to baseline. Dependence in bathing decreased between Time 2 and Time 3. Statistically significant improvements were found in personal and social aspects of clients' perception of the supportiveness of their housing environment between Time 2 and Time 3.
Gitlin, Corcoran, Winter, Boyce, & Hauck (2001) https://doi.org/10.1093/geront/41.1.4	Level I RCT $N = 171$ primary caregivers living with a family member with AD or a related disorder with reported dependence in at least 2 ADLs, reporting difficulty managing ADL/IADL or a dementia-related behavior (M age = 61, age range = 23–92 yr). Intervention group, $n = 93$ (M age = 59.7 yr). Control group, $n = 78$ (M age = 61.4 yr).	<i>Intervention</i> A multicomponent program led by an OT included five 90-min home visits to address physical and social environmental modifications and provide education on the impact of the environment on dementia-related behaviors. <i>Control</i> The intervention group participated in an average of 4 sessions; 75% of recommendations were implemented. Usual care.	<ul style="list-style-type: none"> • Memory and Behavior Problems Checklist • FIM (ADL/IADL Dependence) • Self-efficacy and upset Likert scales 	Caregivers in the intervention group reported less decline in IADL dependence in the person with dementia than did control group caregivers at 3-mo posttest. Intervention spouses reported reduced upset. Intervention women reported enhanced self-efficacy in managing behaviors Intervention women and minorities reported enhanced self-efficacy in managing functional dependency.
Gitlin, Miller, & Boyce (1999)	Level III Pretest–posttest Phase 1, $N = 34$ people age 70 yr and older with ≥ 3 chronic conditions and/or a diagnosis of stroke, hip fracture, amputation, balance difficulties, or rheumatoid arthritis (85.3% women; M age = 76 yr). Phase 2, $N = 75$ people who had received equipment within 3 mo from a bathroom modification program targeting non-home-owning frail older adults.	<i>Intervention</i> OT observed bathing and toileting tasks, prescribed and had bathroom equipment installed, and provided training to safely use the equipment.	<ul style="list-style-type: none"> • Self-reported adherence and level of independence in performing bathing and toileting 	Clients who received OT intervention reported significant improvement in bathing and toilet transfers. Clients reported high adherence (84%) to using equipment; 65% reported difficulty with the equipment (vendor or safety related).

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Supplemental Table 1. Evidence for the Effectiveness of Home Modification Interventions on Participation of Community-Dwelling Adults and Older Adults (cont.)

Author/Year	Level of Evidence/Study Design/Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Gitlin et al. (2003) https://doi.org/10.1093/geront/43.4.532	Level I RCT <i>N</i> = 190 primary caregivers living with a community-residing person with AD or a related disorder. Care recipient (<i>M</i> age = 60.5 yr) had a minimum of 1 limitation in ADLs or 2 dependencies in IADLs. ESP group, <i>n</i> = 89 (<i>M</i> age = 60.4 yr). Control group, <i>n</i> = 101 (<i>M</i> age = 60.5 yr).	<i>Intervention</i> An OT provided five 90-min home visits and one 30-min phone contact to educate caregivers about dementia and the impact of home environments, instruction in problem solving, and approaches to manage caregiving concerns involving physical and social environmental modification; implementation of tailored environmental strategies; and generalization of the strategies. <i>Control</i> Usual care.	<i>Person With AD</i> <ul style="list-style-type: none"> Modified FIM Modified Revised Memory and Behavior Problem Checklist <i>Caregiver</i> <ul style="list-style-type: none"> Caregiver reaction (upset) scales Caregiving Mastery Index Task Management Strategy Index 	At 6 mo, the treatment did not significantly change hours spent helping with IADLs, upset with providing ADL and IADL assistance, and perceived change in somatic symptoms. No statistically significant treatment effects were found for outcome measures related to care recipient functioning. Caregivers reported using significantly less help from family and friends for ADL activities. Women in the ESP program showed a significant reduction in the no. of days they received help with ADLs compared with control group women. Men in the ESP group reported a significant reduction in time spent caregiving compared with men in the control group. Women showed a significant improvement in their ability to manage caregiving.
Gitlin et al. (2006) https://doi.org/10.1111/j.1532-5415.2006.00703.x	Level I RCT <i>N</i> = 319 urban-dwelling older adults who reported difficulty with 1 or more ADLs (<i>M</i> age = 79 yr). Intervention group, <i>n</i> = 160 (<i>M</i> age = 79.5 yr). Control group, <i>n</i> = 159 (<i>M</i> age = 78.5 yr).	<i>Intervention</i> OT (four 90-min sessions, one 20-min telephone contact) and PT (one 90-min session) home visits over 6 mo to provide home modifications and training; instruction in problem-solving strategies, energy conservation, and fall recovery techniques; and balance and muscle strength training. Three follow-up telephone calls were made by the OT over an additional 6 mo, and a final home visit was conducted. <i>Control</i> No intervention.	<ul style="list-style-type: none"> Self-report measures of functional difficulties with ambulation, IADLs, ADLs, use of adaptive strategies, presence of home hazards 	At 6 mo, the intervention group reported significantly less difficulty with IADLs and ADLs than the control group. The greatest benefits occurred in bathing and toileting. The intervention group reported significantly less fear of falling, greater self-efficacy in managing daily activities, greater use of control-oriented strategies, and reduced home hazards than the control group. The average cost for equipment and home modifications was \$439.
Graff, Verbooji-Dassen, Hoefnagels, Dekker, & de Witte (2003) https://doi.org/10.1177/153944920302300403	Level III Single-group design (pre-post) <i>N</i> = 12 older adults with mild to moderate cognitive impairment (<i>M</i> age = 79.9 yr) and their primary caregiver (<i>M</i> age = 56.6 yr).	<i>Intervention</i> OT treatment over 7 wk during a hospital visit (4 treatment sessions) and in home (10 visits) addressing education, problem solving, training in effective coping strategies, and practical and emotional support in how to deal with their relatives' cognitive problems.	<ul style="list-style-type: none"> AMPS Interview for Deterioration of Daily Activities in Dementia COPM 	Motor and process skills increased significantly, and the need for assistance with performing daily activities decreased significantly at 7 wk. Sense of competence in caregivers significantly improved. Self-perception and satisfaction in occupational performance significantly improved for the participants with cognitive impairments.

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Supplemental Table 1. Evidence for the Effectiveness of Home Modification Interventions on Participation of Community-Dwelling Adults and Older Adults (cont.)

Author/Year	Level of Evidence/Study Design/Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Graff et al. (2006) https://doi.org/10.1136/bmj.39001.688843.BE	Level I Single blind RCT <i>N</i> = 135 people age 65 yr or older with mild to moderate dementia living in the community. Occupational therapy group, <i>n</i> = 68 (patient, <i>M</i> age = 79.1 yr; caregiver, <i>M</i> age = 66.0 yr). Control group, <i>n</i> = 67 (patient, <i>M</i> age = 77.1 yr; caregiver, <i>M</i> age = 61.3 yr).	<i>Intervention</i> Ten 1-hr OT sessions over 5 wk to identify potential interventions and instruct participants in how to use compensatory and environmental strategies. Caregivers were trained to use effective supervision and problem-solving and coping strategies. <i>Control</i> No OT.	<ul style="list-style-type: none"> • AMPS • Interview for Deterioration of Daily Activities in Dementia • Sense of Competence Questionnaire 	Participants who received OT showed significant improvements in daily life functioning at 6 wk and 3 mo. Primary caregivers felt significantly more competent. Caregivers' sense of competence was significantly better at 12 wk.
Hagsten, Svensson, & Gardulf (2004) https://doi.org/10.1080/00016470412331294435	Level I RCT <i>N</i> = 100 age 65 yr and older, living independently and not using walking or technical aids. OT training program and usual care (nursing and PT), <i>n</i> = 50 (<i>M</i> age = 81 yr). Control, <i>n</i> = 50 (<i>M</i> age = 79 yr).	<i>Intervention</i> OT provided 45- to 60-min individualized ADL training during the hospital stay. A home visit was conducted during inpatient stay (with the participant) to determine how to prepare and adapt the home environment. <i>Control</i> Usual care, no OT.	<ul style="list-style-type: none"> • Klein-Bell ADL Scale • Disability Rating Index (ADL and IADL performance) 	At 2 mo, all participants regained ADL and IADL abilities. Half of the control group participants received technical aids and home modifications; 90% received "preventive changes" (e.g., removal of throw rugs).
Hendriks et al. (2008) https://doi.org/10.1111/j.1532-5415.2008.01803.x	Level I RCT <i>N</i> = 333 older adults age 65 and older who presented in the emergency room after a fall. Intervention group, <i>n</i> = 166 (66.9% women; <i>M</i> age = 74.5 yr). Usual care group, <i>n</i> = 167 (70.1% women; <i>M</i> age = 75.2 yr).	<i>Intervention</i> A medical assessment followed by a single in-home functional and environmental assessment by an OT with written recommendations. Adults needing modifications or additional support were referred to social and community services. <i>Control</i> Usual care.	<ul style="list-style-type: none"> • Falls (self-report) • Frenchay Activities Index • Groningen Activity Restriction Scale • Fear of falling • Social participation • EuroQual quality of life measure 	The intervention group's self-reported adherence to referrals and OT recommendations was 75%. No significant change between groups seen in falls or daily functioning. Daily functioning significantly improved in participants age 80 yr and older when comparing intervention group with control group.
Huang & Acton (2004) https://doi.org/10.1111/j.0737-1209.2004.21307.x	Level III RCT <i>N</i> = 120 cognitively intact residents of this community who were 65 years of age and older.	<i>Intervention</i> Three home visits in a 4-mo period with standardized and individualized fall prevention teaching and an individualized brochure based on fall-related risk factors (medication and environmental safety).	<ul style="list-style-type: none"> • Falls (self-report) • Falls Efficacy Scale • Environmental Hazards checklist (developed for the study) 	At 2 mo, the incidence of falls was reduced in the in both groups, and fall self-efficacy improved for both groups. There were fewer self-reported environmental hazards and improved medication knowledge for participants in the treatment group.

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Supplemental Table 1. Evidence for the Effectiveness of Home Modification Interventions on Participation of Community-Dwelling Adults and Older Adults (cont.)

Author/Year	Level of Evidence/Study Design/Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
	Intervention group, <i>n</i> = 60 (<i>M</i> age = 72.37 yr). Control group, <i>n</i> = 60 (<i>M</i> age = 71.58 yr).	<i>Control</i> Standardized fall-prevention brochure.		
La Grow, Robertson, Campbell, Clarke, & Kerse (2006) https://doi.org/10.1136/ip.2006.012252	Level I RCT; 2 × 2 factorial design <i>N</i> = 391 people age 75 and older with a distance visual acuity of 6/24 m or worse, living in the community, and ambulatory. Home safety group, <i>n</i> = 100. Otago exercise program and vitamin D group, <i>n</i> = 97. Exercise and home safety group, <i>n</i> = 98. Social visit control group, <i>n</i> = 96.	<i>Intervention</i> <i>Home safety group</i> : A home safety checklist was provided with discussion by an OT. The OT facilitated provision of and payment for new equipment, depending on price and type of item. <i>Otago exercise program</i> : 1 yr of a modified exercise program with vitamin D supplementation. <i>Control</i> 2 hour-long home visits.	<ul style="list-style-type: none"> Falls (hazard and non-hazard related) 	At follow-up, 90% of the home safety group reported complying partially or completely with 1 or more of the recommendations. Hazard-related and non-hazard-related falls were reduced in the home safety group compared with the control group.
Lin, Wolf, Hwang, Gong, & Chen (2007) https://doi.org/10.1111/j.1532-5415.2007.01146.x	Level I RCT <i>N</i> = 150 adults age 65 and older (<i>M</i> age = 76.8 yr) with a recent fall requiring medical attention in the previous 4 wk. Educational group, <i>n</i> = 50. HSAM group, <i>n</i> = 50. Home-based exercise training group, <i>n</i> = 50.	<i>Intervention</i> Interventions were provided in participants' home biweekly for 4 mo. <i>Educational group</i> : Social visit and pamphlets on fall prevention provided by a public health worker. <i>HSAM group</i> : Safety assessment (prespecified list of 14 home hazards) and recommendations for home hazard removal provided by a public health worker. Modifications were provided. <i>Home-based exercise training group</i> : An individualized stretching, strengthening, and balance training program provided by a PT.	<ul style="list-style-type: none"> OARS ADL scale Falls (self-report) WHOQOL-BREF Fear of falling Abbreviated Injury Scale 	WHOQOL-BREF scores over the intervention period for the HSAM group improved but were not statistically significant. No difference was found in risk of falls between the HSAM and control groups. The exercise training group improved significantly on all outcome measures except depression.
Mann, Ottenbacher, Fraas, Tomita, & Granger (1999) https://doi.org/10.1001/archfam.8.3.210	Level I RCT <i>N</i> = 104 elderly adults (73 women, 31 men; <i>M</i> age = 73 yr) with difficulty in ≥1 area on the FIM motor scale. Intervention group, <i>n</i> = 52 (<i>M</i> age = 74.3 yr). Control group, <i>n</i> = 52 (<i>M</i> age = 71.6 yr).	<i>Intervention</i> OTs performed in-home assessments, provided recommendations, and made provisions for the delivery of assistive technologies and environmental modifications. A home modification technician trained participants to safely use the modifications.	<ul style="list-style-type: none"> FIM OARS instrument Pain as measured with the Functional Status Index 	At 18 mo, both groups declined in functional status, but the decline in the intervention group was significantly less than that in the control group. Pain increased significantly more in the control group.

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Supplemental Table 1. Evidence for the Effectiveness of Home Modification Interventions on Participation of Community-Dwelling Adults and Older Adults (cont.)

Author/Year	Level of Evidence/Study Design/Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Nikolaus & Bach (2003) https://doi.org/10.1046/j.1532-5415.2003.51102.x	Level I RCT <i>N</i> = 360 adults (<i>M</i> age = 81.5 yr) showing functional decline, especially in mobility, admitted from home to a geriatric hospital. Home intervention team, <i>n</i> = 181 (<i>M</i> age = 81.2 yr). Control group, <i>n</i> = 179 (<i>M</i> age = 81.9).	All participants received a comprehensive geriatric assessment and recommendations before randomization. <i>Intervention</i> Home hazards were identified while participants were hospitalized, and a follow-up home visit was made after discharge to remove home hazards and train participants to safely use environmental modifications (technical and mobility aids). <i>Control</i> Usual care at home.	<ul style="list-style-type: none"> Falls (self-report) Barthel Index (ADLs) Lawton-Brody Questionnaire (IADLs) 	The intervention reduced reported falls by 31%. 76% of the intervention group participants made ≥ 1 recommended change. Participants who made ≥ 1 of the recommended changes experienced a significant reduction in the rate of falls. The sensitivity analysis found that the no. of falls among participants in the intervention group with no home modifications did not significantly differ from the no. of falls in the control group. The proportion of frequent fallers (>2 falls) was not significantly different between the intervention and control groups.
Pardessus et al. (2002) https://doi.org/10.1097/00002060-200204000-00002	Level I RCT <i>N</i> = 60 participants (<i>M</i> age = 83.5 yr) who were hospitalized for falling. Home intervention group, <i>n</i> = 30 (<i>M</i> age = 83.5 yr). Control group, <i>n</i> = 30 (<i>M</i> age = 82 yr).	<i>Intervention</i> A home visit was conducted to identify environmental hazards, and modifications were recommended. Simple home hazard removal was accomplished during assessment, if possible. <i>Control</i>	<ul style="list-style-type: none"> Falls (self-report) Hospitalization for fall Institutionalization from fall and death from fall at 6 and 12 mo Katz ADL scale Barberger Gateau et al. IADL scale Functional Autonomy Measurement System 	The rate of falls, hospitalization for falls, institutionalization, and death were not significantly different between the two groups. The decrease in function was significantly more severe in the control group in multiple domains.
Petersson, Kottorp, Bergström, & Lijla (2009) https://doi.org/10.1080/11038120802409747	Level II Quasi-experimental pretest–posttest <i>N</i> = 103 community-dwelling adults age 40 and older (<i>M</i> age = 75.0 yr) aging with disabilities and in need of home modifications. Home modifications group, <i>n</i> = 74 (69% women; 59% living alone; <i>M</i> age = 75.19 yr). Wait-list control, <i>n</i> = 29 (66% women; 66% living alone; <i>M</i> age = 74.5).	<i>Intervention</i> Home modifications for shower and toilet, elevator, ramp, handrail, automatic door-openers, and other modifications (unspecified). <i>Control</i> OTs interviewed participants at baseline and repeated the measure at 2 mo and 6 mo.	<ul style="list-style-type: none"> Client Clinical Assessment Protocol Part I (self-report) 	The intervention group experienced less difficulty than the comparison group in everyday life at 2 mo and 6 mo postmodifications. A small to moderate effect size for home modifications was seen in the intervention group. Time waiting for the home modification had an additional impact on difficulties experienced in everyday life.

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Supplemental Table 1. Evidence for the Effectiveness of Home Modification Interventions on Participation of Community-Dwelling Adults and Older Adults (cont.)

Author/Year	Level of Evidence/Study Design/Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Petersson, Lijla, Hammel, & Kottorp (2008) https://doi.org/10.2340/16501977-0160	Level II Quasi-experimental pretest–posttest $N = 114$ community-dwelling adults age 40 yr and older (M age = 75.3 yr) in need of home modification. Home modification program, $n = 73$ (M age = 75.7 yr). Wait-list control, $n = 41$ (M age = 74.6) yr.	<i>Intervention</i> Home modifications for shower, toilet, elevator, ramp, handrail, and automatic door-openers and other modifications. <i>Control</i> OTs interviewed participants at baseline and repeated the measure 2 mo later.	<ul style="list-style-type: none"> Client Clinical Assessment Protocol Part I (self-report) 	Participants who received home modifications reported a significant improvement in self-rated daily activity abilities and reduced difficulty compared with those in the wait-list control group.
Pighills, Torgerson, Sheldon, Drummond, & Bland (2011) https://doi.org/10.1111/j.1532-5415.2010.03221.x	Level I Pilot 3-armed RCT $N = 238$ community-dwelling adults age 70 and older with a history of 1 or more falls in the previous year. Trained assessor (e.g., nurse's aide)–conducted home hazard assessment, $n = 73$ (M age = 79 yr). Occupational therapist–conducted home hazard assessment, $n = 87$ (M age = 78 yr). Control group, $n = 78$ (M age = 80 yr).	<i>Intervention</i> The 2 intervention groups received the Westmead Home Safety Assessment, conducted in the home. Potential fall hazards were discussed, and minor hazards were resolved during the visit. A written report was provided to the participant, and referrals were made for removing hazards. One group received assessment by an OT; the 2nd group received an assessment by a nurse's aide. <i>Control</i> Usual care.	<ul style="list-style-type: none"> Fall (self-report) Fear of falling Barthel Index Westmead Home Safety Assessment 	<p>A significantly greater no. of recommendations were made and adhered to in the OT group.</p> <p>Fall rate in the OT group was approximately half that in the control group, but the trained assessor group was not significantly different from the control group in falls.</p> <p>No difference was found between the trained assessor or OT groups and the control group in independence in ADLs.</p>
Plautz, Beck, Selmar, & Radetsky (1996)	Level III Single-group pretest–posttest $N = 141$ people age 75 yr and older with 0–6 falls or age 60 and older with 1–6 falls in the past yr (84% women; M age = 75.3 yr).	<i>Intervention</i> Participants received counseling and written material on injury risk factors from a VISTA outreach worker. Homes were assessed using a detailed safety assessment checklist. The interventionists made recommendations and assisted clients with some interventions.	<ul style="list-style-type: none"> Self-report of falls (6 mo), burns, and scalds 	<p>The rate of falls was reduced 59% in the follow-up period.</p> <p>Scalds and burns were decreased significantly.</p> <p>The rate of combined falls, burns, and scalds was significantly reduced.</p>
Poustrup & Jaune (2000) https://doi.org/10.1093/eurpub/10.1.45	Level II Nonrandomized pretest–posttest design. Community-dwelling elderly adults age 65 yr and older. Intervention group, $n = 12,905$. Control group, $n = 11,460$.	<i>Intervention</i> Multicomponent intervention including written and verbal fall prevention information on fall risk factors was delivered to all older adults in the treatment community. Home visits by nurses, general practitioners, and home helpers to identify and educate on home hazards were provided for 70- to 79-yr-olds or those using home help.	<ul style="list-style-type: none"> Fall injury (injury register at hospitals) 	<p>Women in the treatment group had a 46% reduction in fracture compared with the control group.</p> <p>No difference in fractures was found between men in the treatment group and those in the control group.</p>

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Supplemental Table 1. Evidence for the Effectiveness of Home Modification Interventions on Participation of Community-Dwelling Adults and Older Adults (cont.)

Author/Year	Level of Evidence/Study Design/Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Stark (2004) https://doi.org/10.1177/153944920402400105	Level III Nonrandomized pretest–posttest design. <i>N</i> = 29 low-income older adults with functional limitations (22 African American, 5 White, 1 Asian, 1 other; 23 women, 6 men; <i>M</i> age = 67.3 yr).	<i>Intervention</i> Participants received a comprehensive assessment of abilities and environmental barriers. A tailored treatment plan was developed in collaboration with the participants. The modifications were provided, with the therapist training participants in their use.	<ul style="list-style-type: none"> • FIM • COPM • Environmental FIM 	Participants' occupational performance scores went up significantly postintervention. Scores on satisfaction with performance increased significantly.
Stark, Landsbaum, Palmer, Somerville, & Morris (2009) https://doi.org/10.1177/000841740907600s09	Level III Quasi-experimental design, pretest–posttest–posttest prospective study <i>N</i> = 67 people age 60 yr and older (88% women; <i>M</i> age = 81.7 yr) with functional limitations.	<i>Intervention</i> The OT completed a structured in-home evaluation. Home modifications, assistive technology, education, and follow-up training were provided.	<ul style="list-style-type: none"> • FIM 	80% of recommendations were followed. A significant increase was found in functional independence, performance, and satisfaction with performance at 1 mo. No change in functional independence and performance was found from posttest to 2-yr follow-up.
Szanton et al. (2011) https://doi.org/10.1111/j.1532-5415.2011.03698.x	Level I Pilot RCT <i>N</i> = 40 low-income older adults with difficulty with ≥1 ADLs or ≥2 IADLs. Intervention group, <i>n</i> = 24 (<i>M</i> age = 79 yr). Attention control (social visits) group, <i>n</i> = 16 (<i>M</i> age = 77 yr).	<i>Intervention</i> The intervention group received ≤6 visits with an OT, ≤4 visits with a nurse, and an average of \$1,300 in handyman repairs. <i>Control</i> The attention control group received equivalent time with a research assistant.	<ul style="list-style-type: none"> • Difficulty performing ADLs (Katz) and IADLs 	The intervention group demonstrated effect sizes of .63 for reduced difficulty in ADLs, .62 for reduced difficulty in IADLs, .89 for QOL, and .55 for falls efficacy.
Tinetti et al. (1999) https://doi.org/10.1016/S0003-9993(99)90083-7	Level I RCT <i>N</i> = 304 people without dementia age 65 yr and older who underwent surgical repair of a hip fracture and returned home within 100 days. Intervention group, <i>n</i> = 148 (<i>M</i> age = 80.5 yr). Usual care group, <i>n</i> = 156 (<i>M</i> age = 79.4 yr).	<i>Intervention</i> Systematic multicomponent rehabilitation, consisting of home-based therapy, including PT for strengthening and functional therapy by a nurse (based on OT principles) that included task modification, use of adaptive equipment, environmental modifications, psychological interventions, caregiver education and involvement, and referral. <i>Control</i> Usual care: traditional home health services.	<ul style="list-style-type: none"> • Occupational Therapy • Functional Assessment • Complication • Self-reported falls 	No significant difference was found between the groups in ADL performance.

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Supplemental Table 1. Evidence for the Effectiveness of Home Modification Interventions on Participation of Community-Dwelling Adults and Older Adults (cont.)

Author/Year	Level of Evidence/Study Design/Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Tomita, Mann, Stanton, Tomita, & Sunday (2007) https://doi.org/10.1097/00013614-200701000-00005	Level I RCT <i>N</i> = 78 adults age 60 and older living alone with difficulty in ADLs or IADLs and interest in using a computer. Treatment group, <i>n</i> = 34 (88.2% women; 70.6% White; <i>M</i> age = 72 yr). Control group, <i>n</i> = 44 (88% women; 81.8% White; <i>M</i> age = 75.6 yr).	<i>Intervention</i> A 2.5-hr home assessment was completed by an OT or a nurse. The home was retrofitted with sensors. <i>Control</i> Usual care.	<ul style="list-style-type: none"> • FIM • OARS (IADL) • SIP: mobility subsection of dysfunction section • Craig Handicap Assessment and Reporting Technique • Mobility for handicap measure • Mini-Mental State Examination 	<p>The treatment group had a significantly higher cognitive function score on the FIM and maintained functional status at 2 yr.</p> <p>The control group had a statistically significant decline over 2 yr.</p> <p>The control group declined significantly in IADLs, whereas the treatment group did not show a significant decline.</p> <p>The rate of independent living in the treatment group was significantly higher than that in the control group.</p>
Van Haastregt et al. (2000) https://doi.org/10.1136/bmj.321.7267.994	Level I RCT <i>N</i> = 316 people age 70 yr and older living in the community with moderate mobility impairments or a history of ≥2 falls in the previous 6 mo. Intervention group, <i>n</i> = 159 (<i>M</i> age = 77.2 yr; 62% with below-average income). Control group, <i>n</i> = 157 (<i>M</i> age = 77.2 yr; 66% with below-average income).	<i>Intervention</i> 5 home visits over 1 yr completed by nurses to screen for medical, environmental, and behavioral factors. Participants were given advice and referrals to resolve hazards. <i>Control</i> Usual care; no additional treatment.	<ul style="list-style-type: none"> • Falls (self-report) • Mobility control scale and mobility range scale of the SIP • Frenchay Activities Index • Falls efficacy scale 	<p>There was no difference in fall risk between the groups.</p> <p>The intervention group showed significantly less decline in daily activity than the control group at 12 mo. At 18 mo, this effect was no longer significant.</p> <p>The intervention group's fear of falling was significantly less than that of the control group.</p>
Velligan et al. (2008) https://doi.org/10.1016/j.schres.2008.02.005	Level I RCT <i>N</i> = 120 people with a diagnosis of schizophrenia or schizoaffective disorder, use of an atypical antipsychotic medication other than clozapine, no hospitalizations and a stable living environment for the past 3 mo (<i>M</i> age = 41; range = 18–60). CAT group, <i>n</i> = 40 (<i>M</i> age = 41 yr). GES group, <i>n</i> = 40 (<i>M</i> age = 42 yr). TAU, <i>n</i> = 40 (<i>M</i> age = 40 yr).	<i>Intervention</i> CAT group: Manual-driven series of environmental supports based on a comprehensive assessment of abilities and environment. GES group: Generic set of environmental supports. <i>Control</i> TAU	<ul style="list-style-type: none"> • SOFAS • Multnomah Community Ability Scale 	<p>The CAT group demonstrated a large effect size, and the GES group demonstrated a medium effect size, compared with the control group.</p> <p>Treatment gains decreased with a reduction in session frequency.</p>

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Supplemental Table 1. Evidence for the Effectiveness of Home Modification Interventions on Participation of Community-Dwelling Adults and Older Adults (cont.)

Author/Year	Level of Evidence/Study Design/Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Velligan et al. (2009) https://doi.org/10.1016/j.psychres.2008.03.016	Level I RCT <i>N</i> = 120 adults ages 18–60 yr with schizophrenia or schizoaffective disorder receiving services from community clinics. GES group, <i>n</i> = 38 (<i>M</i> age = 42 yr). CAT group, <i>n</i> = 36 (<i>M</i> age = 41 yr). TAU group, <i>n</i> = 39 (<i>M</i> age = 40 yr).	<i>Intervention</i> CAT group: Manual-driven series of environmental supports based on a comprehensive assessment of abilities and environment. <i>GES group</i> : Generic set of environmental supports. <i>Control</i> TAU	<ul style="list-style-type: none"> • Adherence and utilization • SOFAS • Multnomah Community Ability Scale 	<p>The CAT group differed significantly from the assessment-only group and had an improved mean SOFAS score at 3 mo.</p> <p>The GES group differed significantly from the control group and had an improved SOFAS score at 3 mo.</p> <p>Participants in the CAT group used a higher proportion of supports than those in the GES group.</p> <p>Participants in the CAT group were more likely to improve specific target behaviors than those in the GES group.</p> <p>Participants in both groups who had higher utilization rates had improved SOFAS scores.</p>
Wilson, Mitchell, Kemp, Adkins, & Mann (2009) https://doi.org/10.1080/10400430903246068	Level I RCT <i>N</i> = 91 people who reported a need for equipment; had major muscle weakness, mobility problems, or upper-extremity pain; or reported pain or fatigue that interfered with function (68 women, 23 men; <i>M</i> age = 62 yr, range = 30–89). Impairments included polio, spinal cord injury, rheumatoid arthritis, and other (cerebral palsy, stroke, and peripheral neuropathy). Intervention group, <i>n</i> = 47 (<i>M</i> age = 62 yr). Control group, <i>n</i> = 44 (<i>M</i> age = 62 yr).	<i>Intervention</i> In-home assessment by an OT and equipment specialist with recommendations for specific home modifications, assistive technology, or behavior modifications. For the majority, devices and necessary training were provided. New assistive technology and assistance were available throughout the study. <i>Control</i>	<ul style="list-style-type: none"> • OARS instrument • FIM 	<p>A significant increase in caregiver hours occurred over time for both groups.</p> <p>Both groups showed functional decline with significant findings for FIM and IADL scores over time.</p> <p>The treatment group showed a slower decline in function and reported significantly more desired functional changes at 12 mo.</p>

Note. AD = Alzheimer's disease; ADLs = activities of daily living; AMPS = Assessment of Motor and Process Skills; CAT = Cognitive Adaptation Training; COPM = Canadian Occupational Performance Measure; ESP = Environmental Skill-Building Program; GES = generic environmental supports; HSAM = home safety assessment and modification; IADLs = instrumental activities of daily living; *M* = mean; OARS = Older Americans Resources and Services; OT = occupational therapy/occupational therapist; PT = physical therapy/physical therapist; QOL = quality of life; RCT = randomized controlled trial; SJP = Sickness Impact Profile; SOFAS = Social and Occupational Functioning Scale; TAU = treatment as usual; WHOQOL-BREF = World Health Organization Quality of Life instrument.

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