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.


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 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.”

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.

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.
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 Szanton 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...
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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 & Ivarsson, 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 predischarge 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). Tinnetti 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 (Tinnetti 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 behavioral 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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References


