








REVIEW SUMMARIES

Home and environmental hazards modification for fall prevention among the elderly

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1 | BACKGROUND

Aging is a challenge for the global public health because it increases fall risk, disabilities, cognitive impairment, and comorbidities (Chang et al., 2019; The Lancet Public Health, 2017). Worldwide people aged 65+ who fall at home are 28%–35% per year, people aged 70+ are 32%–42% (Bilik et al., 2017; CDC, 2017; Stevens et al., 2012; WHO, 2008).

Falls are defined as unexpected events in which participants come to rest on a lower level (Lamb et al., 2005). In adults, they are complex and feature multifactorial phenomena (Gazibara et al., 2017), related to environmental factors (31%), lack of physical exercise (17%), and dizziness (13%) (Rubenstein, 2006).

Falls represent a major public health problem (Heinrich et al., 2010): they are consequences for people both physical (e.g., fractures or loss of mobility) and psychological (increasing fear of falling, loss of self-confidence, and social participation; Gunn et al., 2014; Pin & Spini, 2016). Older adults lose autonomy (Milat et al., 2011), experience a decrease in quality of life (Stenhagen et al., 2014), and have increased nursing home admissions (Gill et al., 2013).

Falls can have significant outcomes for the elderly population. According to the Centers for Disease Control and Prevention (CDC, 2020), in 2018, falls were the 11th leading cause of death and

the first cause of fatal or non-fatal injury in people aged 65+ in the United States of America. Moreover, falls are the primary cause of emergency department admission and hospitalization.

Falls incur both direct and indirect costs for society (Piscitelli et al., 2010). For instance, according to the National Institute for Health and Care Excellence (NICE), in 2011, falls in the United Kingdom cost the NHS £2.3 billion per year (National Institute for Health & Clinical Excellence, 2013).

Italy's elderly population is the largest in Europe and one of the largest in the world (United Nations Population & Division, 2019). Preventive activities, interventions, and strategies should be implemented to reduce the age-related disease burden and save money (National Prevention Council, 2016; WHO, 2017a).

Preventive and multifactorial interventions should be implemented and focus on the individualized risk factors. They should not limit individuals' freedom, dignity, or quality of people's life (Vance, 2012). Research has long shown that home assessment and modification is an effective intervention to prevent falls and fall-related injuries: a well-designed environment protects people from home injuries and hidden fall hazards in daily activities (WHO, 2017a). Aging decreases people's abilities, so home design must accommodate their characteristics, minimizing barriers and increasing participation in activities of daily living (National Research Council, 2010).

*The IPEST Working Group members are listed in the Appendix section.

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International literature suggests installing zero-step entrances, short hallways, motion-sensor lightening, as well as removing rugs, adding grab bars or ramps, reorganizing furnishings, and similar interventions (Pynoos et al., 2010). According to a Cochrane review, the range of modifications and their costs are wide, and literatures are often inconclusive about the most cost-effective interventions and the best ways to implement them (Hopewell et al., 2018).

A prevention tool should be developed to guide local health authorities in delivering evidence-based interventions that improve the quality and the safety of care. The evidence-based manual should also support professionals in promoting healthy aging programs. This sets up the following framework: Effective, Sustainable, and Transferable Preventive Interventions (IPEST; Faggiano et al., 2018).

The aim of this study is to develop an implementation tool for effective, sustainable, and transferable home assessments and modification interventions to prevent falls and fall-related injuries in community-dwelling older people.

2 | RESEARCH QUESTIONS

The research questions (see Appendix S1 for further details), which were formulated according to the population, intervention, comparison, outcome (PICO) methodology (Richardson et al., 1995), are as follows:

1. Is home assessment and modification effective in reducing the number of falls and fallers and the fear of falling in community-dwelling older adults?
2. Which home layout interventions are the most effective in reducing the number of falls and fallers in community-dwelling older adults?
3. How should these interventions be structured and delivered to community-dwelling older adults?

3 | METHODS

The IPEST framework (Figure 1) that can be used to develop effective, sustainable, and transferable preventive interventions was applied in this study (Faggiano et al., 2018). The framework has two main components.

The first is a review of the scientific literature (guidelines, systematic reviews, and randomized controlled trials), including evidence-based activities, actions, interventions, programs, and strategies about home assessment and modification interventions to prevent falls and fall-related injuries in community-dwelling older

people. This step includes research of previous studies, review of inclusion and exclusion criteria, study selection, quality assessment, data extraction, and analyses. The extracted data have been summarized in a narrative way in the draft manual.

The second is to submit the draft manual to achieve a consensus among clinical experts about (1) sustainability in social terms (the intervention must not increase social inequalities related to gender, socioeconomic aspects, and cultural differences, among others), economic terms (e.g., cost efficacy), and in terms of time (positive effects should continue after the intervention has stopped), and (2) transferability in the local context given the barriers and resources. The draft manual has been modified according to the expert opinions, and the final manual has been created.

4 | LITERATURE REVIEW

4.1 | Study research

Following the hierarchy of the evidence pyramid, we looked for guidelines, systematic reviews, and randomized controlled trials (RCTs) that answered our research questions. We searched for guidelines on the websites of scientific societies, institutions, organizations, and associations. The MEDLINE, Embase, and Cumulative Index of Nursing and Allied Health Literature (CINAHL) databases were screened for systematic reviews and RCTs (see Appendix S1 for the search strategy).

4.2 | Inclusion and exclusion criteria

We included guidelines, systematic reviews, and RCTs in Italian and/or English published between January 1, 2015 and July 15, 2019. We excluded studies with narrative or observational approaches, grey literature, editorials, expert opinions, reports, studies with inconclusive results, studies that were cited in already included papers, and studies that focused on populations with severe cognitive impairment or populations that were not self-sufficient.

4.3 | Study selection

Guidelines were searched independently by four reviewers (D.C., A.A., L.I.F., S.P.). Two reviewers (L.I.F., S.P.) independently looked for reviews and RCTs. First, they read the titles and abstracts of the identified papers and eliminated irrelevant studies. Second, they read the papers in their entirety to identify those eligible for



FIGURE 1 IPEST framework process [Color figure can be viewed at wileyonlinelibrary.com]

TABLE 1 Quality assessment rating. The table shows the percentages applied to classify the studies according to quality, and related graphic representation

| Percentage of excellent quality criteria | Evaluation | Graphic representation |
|--|------------|------------------------|
| ≤30% | Low | - |
| 31%–50% | Sufficient | + |
| 51%–75% | Good | ++ |
| >75% | Excellent | +++ |

inclusion. The reviewers managed disagreements by reaching a consensus or consulting a third reviewer (D.C.).

Studies were selected following the hierarchy of evidence of effectiveness, and then were excluded according to the following criteria:

- guideline, if already contained within other more recent guidelines;
- systematic review, if already contained within an included guideline;
- RCT, if already included within guidelines or systematic reviews included.

4.4 | Quality assessment

Guidelines were assessed with the Appraisal of Guidelines for Research & Evaluation II (AGREE II; Brouwers et al., 2012), a tool that evaluates scope and purpose, stakeholder involvement, rigor of development, clarity of presentation, applicability, and editorial independence and provides an overall guideline assessment. The final score was calculated as the arithmetic mean of the results from each domain.

Systematic reviews were assessed with the following tools:

- Measurement tool to assess systematic reviews (AMSTAR; Shea et al., 2007), integrated with
- Preferred reporting items for systematic reviews and meta-analysis (PRISMA; Moher et al., 2009) and criteria to quantify the strength of evidence.

First, we calculated the AMSTAR score. Reviews were given one point if each item received a “Yes” on an AMSTAR item and obtained the maximum rating (if the method was correct) on PRISMA. Second, the score was integrated based on the criteria for the strength of evidence. We added a point if there was a low reporting bias or if the review was done with RCTs. We removed a point if the results were influenced by bias, if the results were inconsistent, or if the outcome was indirect or subjective.

RCTs were assessed with the Cochrane Risk of Bias Tool (Jüni et al., 2001).

The quality of evidence was summarized with a qualitative four-position scale (low, sufficient, good, and excellent), which

represents the percentage of excellent quality evidence to the total evaluated evidence (Table 1; Faggiano et al., 2018).

Only studies rated “excellent” were included. Five authors (D.C., A.A., S.P., L.I.F., S.B.) independently assessed the quality and managed disagreements by reaching a consensus.

4.5 | Data extraction and analysis

Three authors independently (A.A., L.I.F., S.P.) extracted the data. For guidelines, the society and year of publication, recommendations, strength of evidence, and references were extracted. For systematic reviews, the author and year of publication, the typology and number of included studies, the objectives and target population, and the outcomes and effect size were extracted. For RCTs, the author and year of publication, the type of study, the objectives and target population, and the outcomes and effect size were extracted.

Data on the sustainability and transferability of each intervention were also obtained. See Appendix S3 for the data extraction of the included guidelines. Analyses and narrative syntheses of the data obtained were carried out in order to create the draft manual.

5 | CLINICAL EXPERTS' CONSENSUS

A draft of the user manual for implementing effective home assessment and modification interventions was developed based on the IPEST method (Faggiano et al., 2018). The manual was then discussed with an expert panel (IPEST Working Group) to assess the local transferability and sustainability.

The panel included the following health care professionals:

- a nurse expert in gerontology, geriatrics, and primary care
- a nurse in charge of territorial social assistance
- a nurse coordinator of home nursing services
- a nurse coordinator of home care facility
- a family and community health nurse
- a coordinating nurse and president of the Italian Association of Family and Community Nurses
- a physiotherapist
- a nurse coordinator
- a medical director of geriatrics.

All individuals participating in the consensus gave their verbal consent. Two authors (S.C., D.C.) informed all the participants about the study aim and that the results would be anonymous. The data were accessible only to the research team members (The Italian Data Protection Authority, 2018).

A semistructured interview as developed. The interview session lasted one hour and was audio recorded and transcribed (A.A.). Two authors (A.A., D.C.) repeatedly read the transcript and identified the categories, followed by the themes (Mason, 2018; Patton, 2014).

The authors organized the data by bracketing the information (Fischer, 2009). Two authors (A.A., D.C.) made additions to the manual (see the Appendix S4) before submitting it back to the experts' judgment.

6 | RESULTS

On February 1, 2019, we identified 14 scientific societies, institutions, and associations that had published guidelines on fall prevention. Only two met the eligibility criteria and passed the quality assessment and therefore included in the study (Figure 2). On July 23, 2019, we identified 591 systematic reviews and RCTs. None of the reviews met the eligibility criteria (Figure 3), and none of the RCTs passed the quality assessment (Figure 4).

Two guidelines were selected, Registered Nurses' Association of Ontario (RNAO) and WHO. Either were rated "excellent," with overall scores 85% and 87%, respectively. The RCT was assessed as "good" (Pey June Tan 66.7%) and was therefore excluded from the analysis (see Appendix S2 for the quality assessment).

6.1 | Best home modification to reduce falls

Home modification is an effective strategy for reducing the number of falls and fallers in community-dwelling older adults, mostly among those who are classified as having a high risk of falling. However, little evidence was found about the most effective combinations of interventions. Interventions should be tailored to individuals' needs. Individual risks must be identified before starting the program to

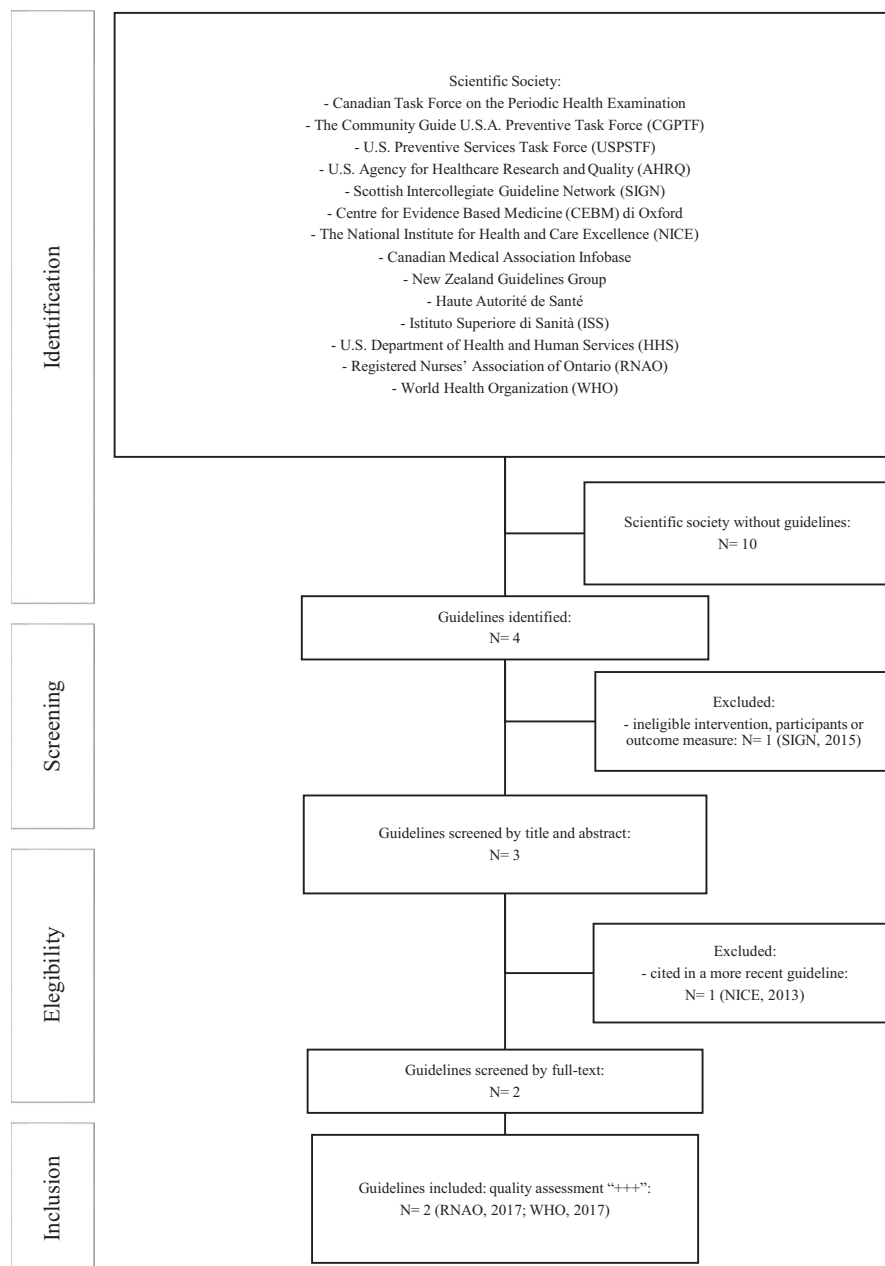
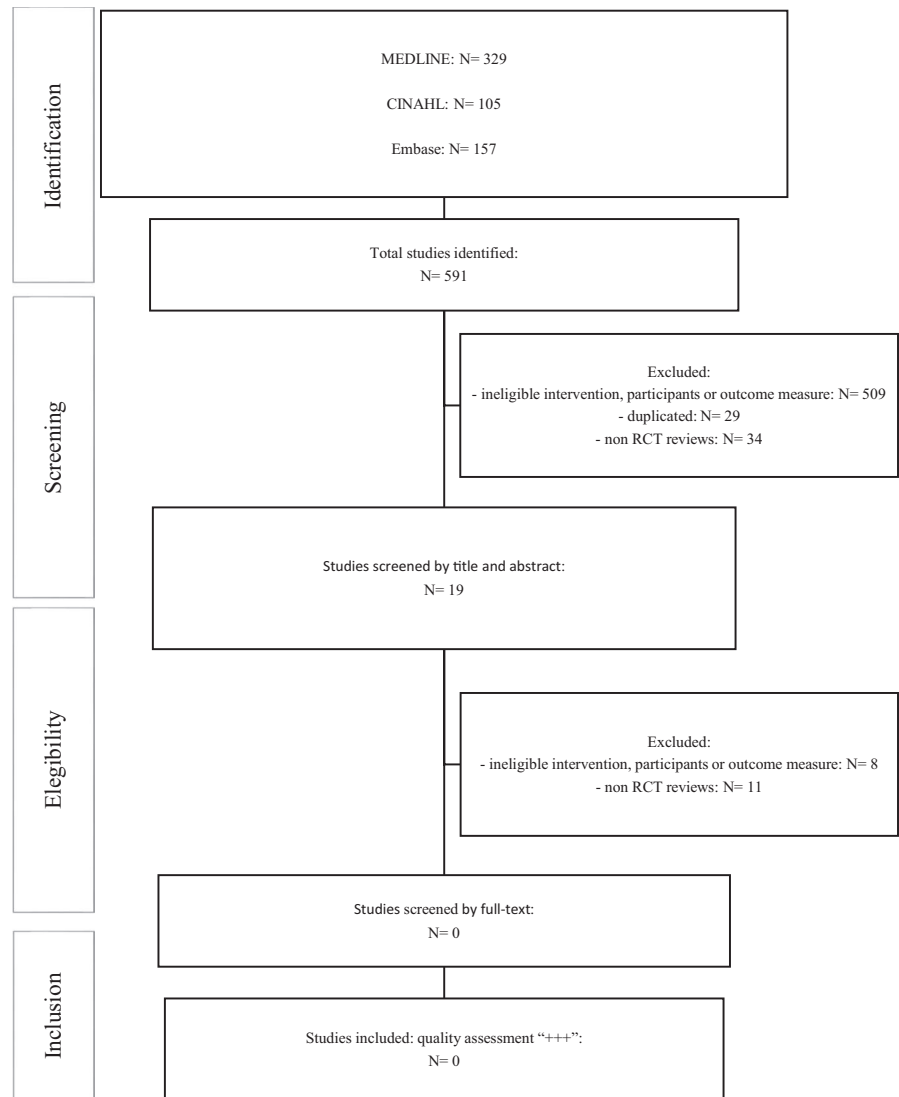


FIGURE 2 Guidelines selection. The diagram illustrates the selection process of the guidelines

FIGURE 3 Systematic reviews selection. The diagram illustrates the selection process of the reviews



produce targeted interventions and maximize their efficacy (RNAO, 2017; WHO, 2017b).

Home modification interventions should consider the following factors in the physical environment:

- appropriate flooring (e.g., slip-resistant flooring, dry surfaces, no parquet or carpets);
- adequate lighting (e.g., night light or supplemental lighting, easy to switch on);
- appropriate furniture (e.g., low bed/chair height, bed side rails, chairs with armrests, and handrails in bathrooms and hallways);
- adequate layouts (e.g., sufficient room to move and use walking aids, all areas uncluttered and cleared of tripping hazards; RNAO, 2017).

The effectiveness of home modification is enhanced in multifactorial interventions that include risk evaluation, health education, environmental modification, the promotion of proper footwear, multifaceted podiatry care, medication reconciliation, and continence management (RNAO, 2017; WHO, 2017b).

In terms of sustainability, we found both barriers to and facilitators of successful implementation. Health professionals must address individuals' lack of a sense of urgency or motivation to change behaviors in order to raise their awareness of being at risk of falling. Every home modification must be discussed and approved by individuals and their caregivers to produce targeted and lasting change. Furthermore, the lack of financial resources could be a major barrier for both individuals and society (RNAO, 2017).

Regarding transferability, we found that trained professional (including doctors, occupational therapists, nurses, and physiotherapists) can carry out home hazard assessments and modifications (WHO, 2017b).

A draft version of the user manual was created from a summary of evidence, and submitted to the expert panel to discuss the transferability, sustainability, and implementation of the intervention in the Italian context. The following findings and suggestions emerged from the consensus: First, fall-risk assessment tools are useful in completing clinical judgment. Second, interventions must be delivered by trained health professionals (e.g., nurses, doctors, occupational therapists, and physiotherapists) who should create a therapeutic alliance with people

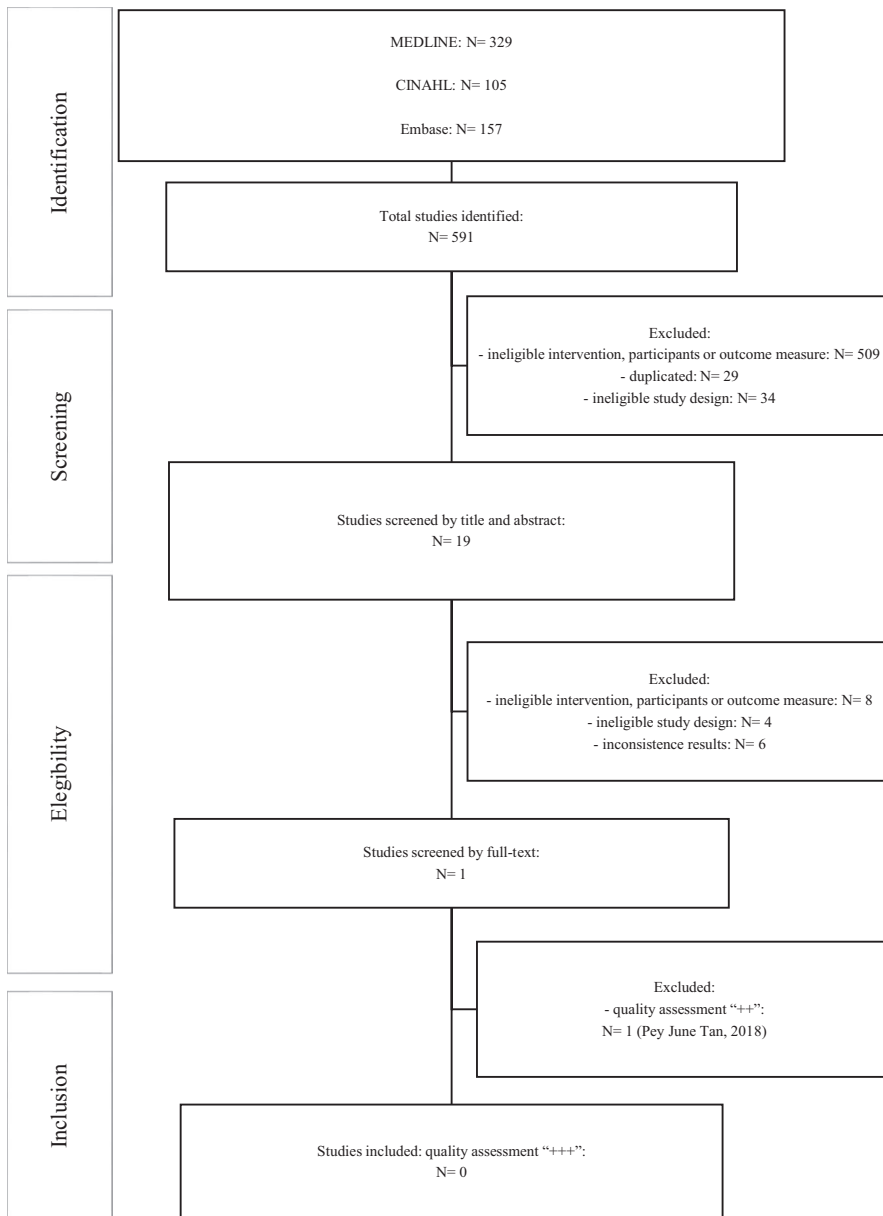


FIGURE 4 RCTs selection. The diagram illustrates the selection process of the RCTs

under their care. Third, it may be useful to deliver simpler and cheaper interventions first to make the environmental change more acceptable. Finally, local institutions (e.g., municipalities and social services) must be involved to ensure economic sustainability.

The manual was modified according to the experts' recommendations, and a final version was created (see Appendix S4 for the full text of the manual).

7 | DISCUSSION

This study aimed to develop a user manual for the implementation of an effective, sustainable, and transferable home assessment and modification intervention, to prevent falls and fall-related injuries among community-dwelling older people. We reviewed the literature according to the hierarchy of evidence (guidelines–systematic

reviews–RCTs) and then filtered the sources through a quality assessment. From the studies included, we extracted recommendations about the efficacy, sustainability, and transferability of home modification programs. We developed an implementation manual draft and discussed it with a panel of experts. After that, a final IPEST version was created.

We found that home/environmental interventions can be effective in reducing the number of individuals who fall and the frequency of falls in community-dwelling people aged 65 and over. The literature suggests using slip-resistant flooring, adequate lightning, appropriate furniture, and an adequate and convenient layout (RNAO, 2017; WHO, 2017b).

Many variables are associated with falls of the elderly in the home environment, such as medical conditions, medications (Lee et al., 2015), and physical inactivity or reduced physical activity (Sherrington et al., 2019).

Elderly patients experience more unstable balance as a result of important cardiovascular therapies that affect blood pressure and heart rate (Pinho-Gomes & Rahimi, 2019).

In addition, clothing and footwear also play an essential role in the incidence of falls in the elderly population (Moncada & Mire, 2017).

Home assessment and modification is a low-cost, highly cost-effective, and high-return intervention (Phelan et al., 2016). It produces health gains in terms of the quality of life among older adults. Moreover, a high fall burden is linked to an inadequate home environment; thus, preventive interventions should focus on accurate home modification (Keall et al., 2017). Before any scaling up an intervention, an efficient way to start the program is to target people at high risk of falls (Pega et al., 2016).

Such an intervention benefits all people staying in the modified homes, not just those at risk of falls. The effectiveness of the intervention is linked to the compliance of individuals at risk of falls and their caregivers (Lord et al., 2006; Pynoos et al., 2010). Thus, the literature and experts suggest making easy and feasible changes first to make the intervention more acceptable (RNAO, 2017).

A multicomponent program to prevent falls in community-dwelling older adults is recommended to create an intervention focused on individual needs and offer additional benefits (e.g., group exercise programs that provide social contact; Wilson et al., 2017).

Similar studies have suggested implementing environmental modification after a comprehensive assessment of individuals' needs and demands. Education is a key step in creating a therapeutic alliance and successful intervention (Maggi et al., 2018).

The economic situation and social interaction of the older adult also play an essential role in the fall event. A relevant study by Pin and Spini (2016) evaluated the interaction between falls and social participation as well as social support. Falls caused a decrease in social involvement and an increase in social support. This social impact of falls can be mitigated by preventive or rehabilitative interventions (Pin & Spini, 2016).

In the Italian context, family and community nurses can be the appropriate health professionals to assess the individual risk of falls and deliver targeted interventions. Nurses should first evaluate the individual risk factors and then involve the person in a multifaceted intervention and a support network to deliver appropriate care. A network of primary care health professionals, hospital specialists, local institutions, and caregivers should be created to deliver the appropriate interventions and support people undergoing the change (e.g., home modification). Long-term sustainability of the intervention is linked to the support and trust of caregivers and the family. Local institutions must promote and finance the intervention, which can be costly.

8 | LIMITATIONS OF THE STUDY

This study has a number of limitations. First, most of the evidence focused on environmental modifications of hospitals or long-term care settings. Nevertheless, some universal precautions may also be

applicable to individual homes. Second, the literature does not specify the types of structural/home modifications that can maximize the effectiveness of the program. It was hard to find papers that studied home modifications as a single intervention and not as part of a multicomponent one. Third, although we included only high-quality sources, the evidence they found was not always of high quality and was often exposed to bias. For instance, we assessed the quality of guidelines with AGREE II, which evaluates the methodological rigor and transparency but not the quality of the recommendations. Fourth, the fall risk of the included populations was assessed with different or unspecified tools, so it was hard to make comparisons. Fifth, the populations of the included studies often excluded persons with specific diseases (e.g., Parkinson's and Alzheimer's disease) that are common in older adults. Sixth, the follow-up period used in most of the included studies was too short, making it difficult to evaluate the long-term effectiveness of the interventions. Finally, the studies did not demonstrate that home modifications reduce falls and fall-related injuries.

9 | IMPLICATIONS FOR RESEARCH

Further studies may be carried out to assess the impact of home modification on other risk reduction interventions so that an appropriate cost-benefit program can be developed. To the best of our knowledge, no studies have compared the effectiveness of individual interventions related to environmental change, especially in relation to the difficulty in making them applicable in everyday practice. However, some studies comparing the effectiveness of environmental modification with other interventions took into account different aspects of home modification (e.g., removing obstacles and installing handrails).

It would be interesting to compare the effectiveness of various types of environmental modification interventions, such as no-cost interventions (e.g., removal of carpets and obstacles or the use of walking aids), low-cost interventions (e.g., reorganizing lighting systems and using handrails and chairs with armrests), and high-cost interventions (e.g., changing the layout and installing elevators). Moreover, it is important for future studies to demonstrate that environmental modification can reduce falls and fall-related injuries.

10 | IMPLICATIONS FOR PRACTICE

The manual that we created can be used to implement home modification programs to reduce the number of falls and fallers among community-dwelling older adults. The IPEST methodology is useful in producing user-friendly evidence to support health workers in everyday practice. This IPEST manual has not yet been widely implemented, so there is still little experience in this area. The operating manual needs strategies for transferability and implementation in local contexts.

11 | CONCLUSION

Home modification is an effective preventive program in reducing falls and fallers among older community-dwelling adults aged 65 and over. The IPEST user manual can help clinicians, health professionals, and stakeholders to implement environmental change interventions. However, promoting healthy aging remains the most effective strategy for reducing costs and morbidity in the elderly population.



CONSENT OF INTEREST

All authors approved the manuscript and publication.

CONFLICT OF INTERESTS

The authors declare they have no competing interests.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section. **How to cite this article:** Campani D, Caristia S, Amariglio A, et al; IPEST Working Group. Home and environmental hazards modification for fall prevention among the elderly. *Public Health Nurs*. 2021;38:493–501. <https://doi.org/10.1111/phn.12852>

APPENDIX

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