

Weatherization and Home Improvements: A Promising Path for Improving Health and Reducing Medical Costs for Older Adults

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Abstract

High medical and energy costs, limited incomes, and narrow comfort ranges present multiple health-related challenges for older adults. A variety of studies indicate that weatherizing and repairing the homes of elderly households can help to address some of these issues, ultimately improving resident health and reducing energy and health costs. Essentially, weatherization and home repairs can serve as preventative healthcare in some situations. Several pilot programs have recently been launched that build on these findings. Additional pilots and good evaluations of their impacts are both needed. Ultimately, these programs hold promise for improving health and reducing medical costs.

Challenges and Opportunities

High medical and energy costs, limited incomes, narrow comfort ranges and vulnerability to extreme temperatures present multiple health-related challenges for older adults. The section below summarizes the key data and research findings illuminating these relationships. The next section then summarizes studies showing how programs to weatherize and repair the homes of elderly residents can improve health and reduce costs, effectively serving as a form of preventive healthcare. The paper concludes with a discussion on recommended next steps.

A Set of Interlocking Challenges

Older adults have higher medical costs than average Americans; the majority of these medical costs are paid by the federal government.

According to data compiled by Centers for Medicaid and Medicare Services (CMS), healthcare spending for people aged 65 and over averages \$19,098 per person per year, about triple the average spending for working-age adults (\$7,153 per person per year) (CMS 2019).

A 2015 analysis of data from the Medicare Current Beneficiary Survey by the Federal Reserve Bank of Chicago finds that Medicare accounts for 55% of medical spending on the elderly, Medicaid for 10%, and other government programs for 3%. Private insurance and out-of-pocket expenses account for most of the remaining spending (De Nardi et al. 2015).

Costs for nursing homes and other long-term care facilities are substantially higher than the cost of aging in place.

The cost of a nursing home averages \$77,000–88,000 per year (De Nardi et al. 2015). Medicare beneficiaries living in long-term care facilities for at least part of 2006 accounted for 6% of the Medicare population but 17% of total Medicare spending (Jacobson, Neuman, and Damico 2010).

According to the US Department of Health and Human Services, people turning 65 have almost a 70% chance of needing some type of long-term care services and support in their remaining years (HHS 2017). One-third of today's 65-year-olds may never need long-term care support, but 20% will need it for more than five years. This includes 65% who will receive long-term care at home and 37% who will receive care in facilities (some people use both) (HHS 2017). The RAND Corporation estimates that about 5% of older Americans will require stays in nursing homes that cost \$47,000 or more over their lifetimes (RAND Corp. 2017).

Older adults on average have lower incomes, use more energy in their homes, and have higher energy burdens.

According to the US Census Bureau, in 2018 the median US household income was \$61,937, while for those 65 and older, it was 27% lower, or \$44,992 (Guzman 2019). A recent US study that looked at energy use trends as a function of age examined several decades of data and found that energy usage was lowest among young adults, who typically occupy smaller homes; consumption then rises for people 30–54—the peak years of having children and living in larger houses—and then stabilizes for people in their 60s. After age 70, however, consumption begins to rise again. These trends persisted when the researchers controlled

for income and housing type, but they do vary with geography – in warmer US regions, consumption is particularly elevated for the over-70 age group. This last finding is likely due to increased energy use for air-conditioning, but it is unclear whether this is due to increased use of air-conditioning (lower set points, more operating hours per year) or to the over-70 age group occupying less-efficient homes (Span 2019).

Due to their lower incomes and higher energy use, older adults are more likely to spend a significant share of their income on energy. The proportion of income that people spend on energy is called their *energy burden*. Energy burdens of 6% or more are considered high. Using the latest data from the American Community Survey, 24% of US households have high energy burdens, yet among older adults (65 and over) this increases to 34% (Drehobl 2019).

Older adults have a narrower comfort range and are more susceptible to extreme temperatures.

Citing a variety of other papers, Miller, Vine, and Amin (2017) and van Hoff et al. (2017) note that, on average, older people do not judge temperatures as well as younger people, are physically comfortable in a narrower range of temperatures, and are more vulnerable to temperatures outside generally accepted ranges. For example, van Hoff and colleagues note that “older adults experience a decline in the efficiency of their cold and warm defense mechanisms and in their ability to detect and therefore respond to temperature changes.” This finding likely contributes to the fact that, during periods of extreme heat or cold, the elderly are much more likely to die or require medical care. For example, during Chicago’s July 1995 heat wave, people over 65 accounted for 72% of the 514 heat-related deaths (Span 2019). And, in Maricopa County, Arizona (Phoenix and vicinity), of the 132 heat-related deaths in 2018 for which age is known, 73% were people aged 50 or older. The heat-associated death rate was highest for those over the age of 65 (Maricopa County Public Health 2019).

Further, a study on elderly deaths during a catastrophic heat wave in France found that the elderly at greatest risk of death during this heat wave were people who met one or more of the following criteria: (a) were confined to bed; (b) had a cardiovascular or neurological disease or mental disorder; or (c) were living either in old buildings without insulation or in areas with the greatest *heat island effects* – that is, areas in which a lack of surrounding green spaces exacerbated high temperatures around buildings (Vandentorren et al. 2006).

Some older adults are reluctant or unable to incur the costs associated with operating or repairing heating and cooling systems; energy costs can also compete with food and pharmaceutical costs.

A study in South Australia found that 78% of elderly in a survey reported that they avoided using heating and cooling systems because they did not want or were unable to spend the money on electricity and gas (Bills and Soebarto 2015). In a study on heat-related deaths in Maricopa County, Arizona, 28% of deaths occurred indoors. Of those indoor fatalities, an air conditioner was available in 82% of cases, but 72% of those air conditioners were nonfunctioning, 11% were functioning but not in use, 8% lacked electricity (whether due to blackouts and/or shutoffs is not stated), and 9% had other or unknown causes (Maricopa County Public Health 2019). In a survey of households that were eligible for the US low-

income weatherization program but did not receive weatherization services, 23% reported that over the previous 12 months, they had limited their food purchases in order to pay an energy bill and 19% reported that they either did not fill a prescription or took less than the full dose of a prescribed medicine in order to pay their utility bills. These findings include both older and younger adults; age breakouts are not reported (Carroll et al. 2014).

Weatherization and Home Repairs Can Help Address These Challenges

Numerous studies have shown that weatherization improvements to homes can have many health benefits (Wilson et al. 2016; E4TheFuture 2016). In this section, we focus on studies that specifically examined health effects for older adults.

Common weatherization measures include improving insulation, reducing drafts, and improving heating and cooling systems. Such weatherization not only reduces energy use and energy bills but also improves occupant comfort. Further, these programs can be leveraged to protect health and safety by providing targeted home repairs such as mold and moisture remediation, and mitigation of trip-and-fall hazards. Such in-home modifications can preventively reduce various common health harms that older adults face, including exposure to conditions that exacerbate asthma, chronic obstructive pulmonary disease (COPD), and other respiratory diseases; falls; and exposure to extreme heat or cold.

Weatherization can reduce exposure to extreme indoor temperatures.

Several studies have found that weatherizing inefficient homes and apartments can reduce occupant exposures to extreme heat and cold.

For example, a study in England looked at low-income fuel-poor households that received insulation, new windows and doors, heating system upgrades, and connections to the gas network. The study found that gas use decreased an average of 37% and that the upgrades increased average indoor temperature by 0.84 degrees C, generally bringing temperatures to within a “healthy comfort zone” of 18–24 degrees C. Wall insulation was most effective at raising indoor temperatures; heating system improvements were much less so. The study also included a discussion, with related citations, about why temperature changes should improve health, noting that the impacts result from better heat retention in the home and from making adequate heating more affordable (Poortinga et al. 2017).

Another study looked at heat stress – that is, exposure to high temperatures for at least six hours – during heat waves in Australia. It found that residents of inefficient homes (an average of 0.9 stars on Australia’s six-star scale) were approximately 50% more vulnerable to experiencing heat stress during a heat wave than were residents of efficient homes (averaging 5.4 stars). They estimated that upgrading the inefficient homes to the efficient level would reduce the risk of heat stress during a heat wave from 50% to only 4% (Alam et al. 2018).

Major renovation of the elderly’s homes can improve health and well-being.

Studies analyzing substantial renovations of elderly housing show improvements in indoor environments, health, and well-being. For example, when a low-income elderly housing complex in Phoenix was renovated (including roof insulation and new heating/cooling units and thermostats), energy use declined 19%, extreme indoor temperatures (time above

81 degrees F) were reduced, and residents self-reported statistically significant improvements in quality of health/life and hours of sleep, and decreases in emotional distress (Ahrentzen, Erickson, and Fonseca 2016).

Similarly, researchers studied a Minnesota building with 101 units that underwent a green renovation, including new insulation, exterior cladding, air sealing, new heating and ventilation systems, window replacement, Energy Star appliances, asbestos and mold abatement, low-volatile chemicals, moisture-resistant materials, exercise enhancements, and an indoor no-smoking policy. Study respondents, who had a median age of 66, reported statistically significant improvements in mental health (using Veteran's Rand 12 survey results), reduced falls, and reduced instances of tobacco smoke in their apartments (Breyse et al. 2015).

Several studies on green renovations of non-senior housing have found roughly similar results (Wilson et al. 2016). Further, a meta-review on health-related housing improvements (not limited to older adults) found the following:

Data from studies of warmth and energy efficiency interventions suggested that improvements in general health, respiratory health, and mental health are possible. Studies which targeted those with inadequate warmth and existing chronic respiratory disease were most likely to report health improvement... Warmth improvements were associated with increased usable space, increased privacy, and improved social relationships; absences from work or school due to illness were also reduced (Thompson et al. 2013).

Weatherization of elderly COPD patient homes can improve respiratory symptoms.

In a Scottish study, patients previously hospitalized for COPD were offered energy efficiency upgrades (insulation and upgrades to central heating systems). Relative to a control group of similar patients without upgrades, those receiving upgrades reported statistically significant improvements in respiratory system scores, as well as decreased annual fuel costs and improved home energy efficiency ratings (on the UK's 0-10 National Home Energy Rating scale) (Osman et al. 2009).

Weatherization in New Zealand reduced pharmaceutical and hospitalization costs as well as mortality among older adults who had been previously hospitalized for circulatory conditions.

The Warm-Up New Zealand program provided grants toward insulation and new heating systems in thousands of homes. A detailed study on the program's health impacts found that weatherized households had statistically lower costs for pharmaceuticals and hospitalization; further, mortality declined among those over 65 who had been previously hospitalized for circulatory conditions. Impacts were most significant in homes receiving insulation and were often not significant in homes receiving heating system work (Barnard et al. 2011).

Weatherization can improve health and make it easier to pay bills, according to resident self-reports.

The US federal Weatherization Assistance Program provides free weatherization services to low/moderate income households (currently, households with incomes up to 200% of federal poverty guidelines). Over the 2010–2018 period, the program weatherized an average of 40,331 homes annually, of which 39.3% had older residents (aged 60 or over) (E. Burrin, U.S. Dept. of Energy, pers. comm., data on Weatherization Assistance Program participation 2010-2018, January 31, 2020).

A survey of program participants in 2013 relative to their 2011 pre-weatherization survey found statistically significant changes in self reports for a variety of health-related questions, but most of these results applied to an all-ages sample. For several questions, however, statistically significant changes were reported only for older program participants. Post-weatherization, there was a 12% net decline in the portion of elderly respondents reporting poor physical health for all of the past 30 days. There was also a net decline of 20% for the portion of older households reporting that it was hard or very hard to pay energy bills. For all age groups, there were net decreases in the proportion of weatherization recipients reporting that they “could not fill prescription medicine at least every few months to pay for energy bills” (10% decrease) or “could not buy food at least every few months to pay energy bills” (4% decrease). (Although these variables also declined among older adults, due to small sample sizes, their declines were not statistically significant (APPRISE 2018)).

A review of other home improvement studies by Thomson et al. finds that energy efficiency interventions can result in improvements in general health, respiratory health, and mental health. A few studies found reduced absences from work or school due to illness. Studies also showed that interventions targeted at those with inadequate warmth and existing chronic respiratory disease were most likely to report health improvement. The reviewed studies covered a range of ages and were not limited to older adults (Thompson et al. 2013).

Weatherization combined with trip-and-fall prevention can result in significant reductions in falls and fall-related costs.

Nearly 30 million older adults fall each year in the United States; in 2014, for example, falls resulted in about 27,000 deaths and 2.8 million older adults being treated in emergency departments for injuries. Just the Medicare costs associated with these falls were estimated at \$31 billion nationally in 2015 (Bergen, Stevens, and Burns 2016). The cost of hospitalization-related medical services for a fall averages \$30,000 (Burns, Stevens, and Burns 2016). Installing handrails, improving lighting, and other preventive measures will generally cost far less.

There is considerable literature on home modifications that can reduce falls and other accidents among older adults. Studies tend to indicate that home modifications can reduce falls and the need for medical treatment among some elderly populations but not others. For example, home modifications can be effective if targeted at older people with a history of falls or with mobility limitations. To be most effective, home modifications should be complemented with training on improving transfer abilities and other behavior change strategies (Lord, Menz, and Sherrington 2005; Tse 2005).

A pilot program in Connecticut added home repairs aimed at reducing trip-and-fall hazards to an ongoing low-income weatherization program. The pilot provided injury prevention services to weatherization recipients aged 70 and over who self-reported a fall in the previous six months. Specifically, an occupational therapist visited the home to identify recommended repairs, and weatherization crews and contractors then made the repairs at no cost to the resident. Common modifications included installing grab bars, raising toilet height, and installing dual showerhead/hand-held shower fixtures. Most residents were also given nonslip footwear. The median home received 6.5 modifications at a median cost of \$2,058. Services were provided to 49 homes; the pilot program collected health data on 35 of those homes that were also participating in a VoiceCare emergency response system and compared them to a control group of older VoiceCare participants who did not receive weatherization or home modifications. In the participating homes, falls declined from 94% in the six months prior to home modifications to 9% in the six months following modifications. Calls for assistance via VoiceCare declined from 23% to 3%. Both of these declines were statistically significant (Tohn et al. 2020). The study did not evaluate the effect of weatherization-only services on occupant health, but it does show the promise of leveraging the energy workforce to help deliver injury prevention services.

In Vermont, a similar pilot program has begun with the Vermont Weatherization program and University of Vermont Medical Center (E. Tohn, Tohn Environmental Strategies, pers. comm., February 14, 2020).

A home visit and repair program can result in significant medical cost savings.

While not a weatherization program, a pilot program called *Community Aging in Place, Advancing Better Living for Elders (CAPABLE)* provides some useful insights. CAPABLE combines occupational therapy, nursing visits, and home repair services designed to improve the ability of low-income older adults to function at home. The focus is on achieving functional goals set by each patient (e.g., get upstairs, take a shower), and the pilot also includes management of pain medication and depressive symptoms management as well as home repairs that can help catalyze achievement of those functional goals. A study in Baltimore provided CAPABLE services for five months and found that prior to the program, participants had difficulty with an average of 4.1 out of 8 instrumental activities of daily living (e.g., doing laundry, preparing food). At the end of the program, this difficulty decreased to 2.1 out of 8. Comparing participants' Medicare and Medicaid costs to matched control groups found that Medicaid costs decreased an average of \$867 per month – a savings of about \$10,000 per year. In addition, Medicare savings in inpatient and outpatient care were more than \$10,000 per year, for a total savings of approximately \$20,000 per year (Szanton et al. 2018). The program is now being tested in other locations (John Hopkins and Stanford 2018).

While weatherization is not part of this program, it could potentially be offered to households where it would be particularly beneficial (as discussed below).

Discussion and Next Steps

Taken together, these findings show that home weatherization and repair can reduce energy and medical costs for older adults while improving health outcomes. Although weatherization and home repairs likely provide benefits to many older adults, studies show

they are particularly beneficial for certain subpopulations, such as those with COPD, inadequate warmth, and a prior history of falls. Other potential priority groups might be households who find that paying their energy bill makes paying for food or prescriptions difficult, and households in which weatherization and home repairs might allow occupants to age in place and postpone nursing home care.

Several next steps come to mind. Particularly promising is the Connecticut pilot program that added trip-and-fall prevention measures to weatherization programs for elderly residents with a history of falls. Such programs should be further piloted and evaluated. Likewise, for programs such as CAPABLE, which target older adults, the addition of weatherization services should be piloted and evaluated for participants who face problems of inadequate warmth or high energy bills.

Broader evaluations of weatherization services for elderly households would also be useful. As noted earlier, approximately 40,000 homes are weatherized annually, including about 16,000 with elderly residents. The impacts of this weatherization on resident health merits more thorough investigation, in part to estimate overall effects, but even more importantly, to identify subpopulations for which weatherization can be particularly useful. For example, we hypothesize that weatherization can allow more older adults to age in place rather than enter long-term care facilities; a detailed study on weatherization impacts could test this hypothesis. A challenge is to find ways to access and match health and weatherization data while also protecting data confidentiality. A few studies are finding ways to address these challenges, such as an emerging partnership between the Tennessee Valley Authority (TVA) and TennCare to evaluate TVA's Home Uplift program (of which the majority of participants are elderly or disabled), and a joint effort between New York State energy and health agencies to evaluate the impact of weatherization and healthy home measures in 500 homes (E. Parsons, Home Uplift program manager, Tennessee Valley Authority, pers. comm., January 22, 2020) (Office of the Governor, New York 2019). The New York program targets households with children who have asthma, but discussions have begun on a potential future study targeting the elderly.

In addition to the Weatherization Assistance Program, electric and natural gas utilities nationwide administer a network of energy efficiency programs, including home weatherization, that operate in most states. In 2018 alone, spending on these programs totaled approximately \$8.0 billion (Berg et al. 2019). Programs are also offered by some states and municipalities. The existing network of energy efficiency programs can provide a starting point and an established framework for reaching beyond hospitals and clinics and into people's homes to address health preventively.

Hopefully, in the long term, program models can be developed based on successful pilots such as the ones explored here. These models would combine weatherization with home repairs, and they would target the key populations that would most benefit from joint services. Such models offer considerable promise for improving health and for reducing the medical and energy costs of older Americans.

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