Housing, Weatherization, and Health

Prepared for the Orange County Home Preservation Coalition (OCHPC) by UNC Chapel Hill Department of Health Sciences Community Practice Lab

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ORANGE COUNTY NORTH CAROLINA

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ORANGE COUNTY HOUSING DEPARTMENT

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Definitions

Weatherization (Wx): Modifications made to homes that help to insulate, control moisture and temperature, reduce air leakage, improve ventilation, and increase energy efficiency within the home.[1]

Social Determinants of Health: The social, economic, cultural, and environmental factors that influence an individual's health outcomes.[2]

Energy Burden: The percentage of household income that is spent on home energy costs, like heating, cooling, and electricity. [3,4]

Orange County Home Preservation Coalition (OCHPC): a collaborative of organizations that provide home repairs and modifications to Orange County residents.

Executive Summary

This memo explores the relationship between housing quality and health, identifying how home weatherization can improve residents' health outcomes. Findings are contextualized within the state of North Carolina and Orange County, NC.

Housing and Health: The Importance of Weatherization

Housing as a Social Determinant of Health

Housing is recognized as a key **social determinant of health**. Housing affordability, stability, quality, safety, and neighborhood environment all affect the physical and mental health of residents.

Weatherization and Energy Burden

Weatherization, or Wx, refers to modifications made to homes that insulate, control moisture, reduce air leakage, improve ventilation, and increase energy efficiency. Weatherizing a home can reduce **energy burden**, or the amount of money households must spend on heating and cooling their homes. Higher energy burden is associated with poorer health outcomes.

Weatherization and Health

The condition of home environments directly affects the health and well-being of residents.

Cold Home Environment

Inadequate warmth in homes can lead to various health problems, especially for older adults, young children, and others who spend a significant amount of time indoors. Extreme winter temperatures can worsen these issues. Wx can address structural deficiencies like insufficient insulation and air leaks, which improves thermal comfort and health outcomes for residents.

Hot Home Environment

Rising temperatures in home environments can have detrimental effects on health. Wx can help cool indoor temperatures and reduce heat-related health issues, particularly benefiting older adults and children whose bodies struggle with temperature regulation. Weatherization improves thermal comfort, mitigates health impacts, and enhances energy efficiency in cooling homes.

Ventilation and Air Quality

Indoor air quality has significant effects on resident health. Indoor and outdoor factors influence indoor air quality, including ventilation systems, building materials, air pollution, and behaviors like smoking and cooking. Weatherizing a home without proper ventilation can worsen indoor air quality and harm residents' health, highlighting the need for a holistic approach to weatherization and ventilation.

Vulnerable Populations

Some populations are at higher risk of negative health effects from unhealthy home environments. This analysis focuses on elderly, low-income, and Black households because these groups are major recipients of Orange County Home Preservation Coalition (OCHPC) services.

Older Adults

Older adults face a higher risk of health issues from extreme temperatures and indoor air pollution. The bodies of older adults are less responsive to heat and humidity changes and they often spend more time at home than other population groups, making them more susceptible to home health risks. Additionally, low-income older adults experience the highest energy burden in the United States.

Low-Income Households

Low-income individuals are more likely to inhabit older homes that lack insulation and are more difficult and expensive to heat or cool. Higher energy burden limits the household's resources for other essentials like food and healthcare.

Black Residents

Black residents are disproportionately affected by energy burden and poor housing conditions due to historical and ongoing racist housing policies. Structural racism has led to Black families to be more likely to live in less energy-efficient homes and to be located near pollution emitting facilities than non-Hispanic white families. Addressing racial equity is crucial in housing and Wx policies and programs to rectify these disparities.

Conclusion

Understanding the specific needs and challenges faced by populations in Orange County will guide OCHPC's efforts in improving housing quality and reducing energy burden to create healthier home environments.

Weatherization in North Carolina

North Carolina Context

Demographics

The state's population is aging and becoming more racially diverse. Because older adults and households of color can benefit greatly from home Wx, investing in Wx programs will become more important for North Carolina over time.

Federal Poverty Level (FPL)

Many North Carolinians meet the FPL income threshold to be eligible for Wx, but this percentage is highest for the Hispanic/Latinx, American Indian/Alaska Native, and Black/African American populations.

Climate

North Carolina's daytime and nighttime temperatures and relative humidity are projected to increase. Wx retrofits to regulate and cool indoor temperatures and reduce relative humidity will become increasingly important for North Carolina.

Conclusion

Wx is important for North Carolina to support groups most at risk for negative health outcomes of poor home conditions, adapt to climate change, and improve racial and economic equity in the state.

Funding for Home Weatherization

There are a variety of programs and funding streams available to improve delivery of residential Wx at the national, state, and local levels.

Recommendations

Orange County Home Preservation Coalition

- Ensure OCHPC home repair services are equitably reaching elderly, low-income, and Black households.
- Identify strategies to enhance racial equity in OCHPC outreach.
- Evaluate how Wx and HVAC repairs are holistically evaluated and deployed.
- Identify strategies to streamline delivery of Wx and HVAC that can be modeled across the state, especially for vulnerable populations.

State of North Carolina

- Create a Weatherization Working Group (like seen in Minnesota) to assess barriers to service and establish recommendations for the North Carolina Legislature and for State WAP leaders.[5]
    - Working group members may include legislators, low-income advocates, utilities, service providers, community leaders, and others.
- Become a member of the National Association for State Community Services Programs (NASCSP) Racial Equity Work Group (REWG).[6]
- Work Areas of Interest:
    - Increase Wx funding for households of color and communities that have been historically disinvested in.
    - Increase Wx funding for households in areas with poorer air quality.
    - Increase deployment of Wx retrofits that enhance cooling and reduce relative humidity.
    - Strategically target Wx retrofits in areas of the state that are projected to experience the most extreme changes in temperature.

Housing and Health: The Importance of Weatherization

Introduction

This memo explores the relationship between housing quality and health and identifies how weatherizing homes can improve residents' health outcomes. Weatherization (Wx) and health is a key intersection of interest for the Orange County Home Preservation Coalition (OCHPC). OCHPC is comprised of a group of partner organizations that work together to preserve, repair, and modify homes so homeowners can continue living in them comfortably and safely.

Wx is one type of service that OCHPC provides. To evaluate the effectiveness of the Coalition, OCHPC is conducting an evaluation of their home repair program. By reviewing literature of Wx's effects on health, this analysis will contextualize Wx within the context of Orange County, NC, the state, and help develop a clear understanding of how Wx impacts the health and wellbeing of Orange County residents.

Housing as a Social Determinant of Health

Housing is recognized as a key social determinant of health. Housing affordability, stability, quality, safety, and neighborhood environment all affect the physical and mental health of residents.[8,9]

Social determinants of health, or the social, economic, cultural, and environmental factors that influence an individual's health outcomes, have greater influence on health outcomes than genetics alone. [7,10] Because people living in the U.S. spend an average of 90% of their time indoors, building conditions have significant influence on the health of the building residents.[11]

Figure 1: Social Determinants of Health [7]

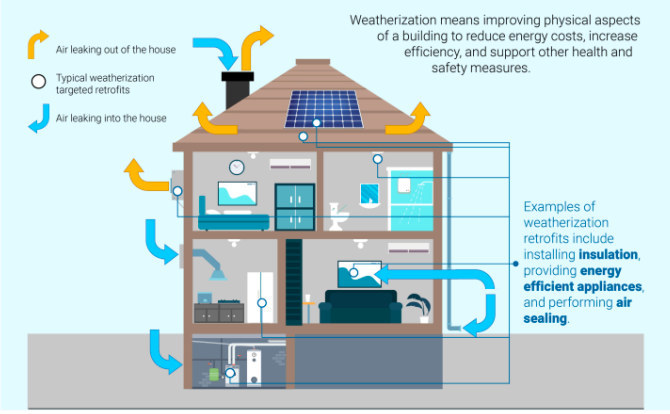
Housing conditions like chronic dampness; presence of mold, asbestos, or lead; poor ventilation; roof leaks; and lack of sufficient heating and cooling can create living environments that negatively impact resident health.[9] For example, poor housing conditions can lead to "thermal discomfort as well as pest infestation, both of which can exacerbate existing chronic health conditions such as arthritis and asthma, respectively".[4]

Indirectly, efficiency of home heating and cooling has health consequences because money spent on energy cannot be used for other essentials such as food, medicine, and healthcare.[12] Treating housing quality as a public health issue and mitigating unhealthy home conditions can improve individual and community health outcomes.[13]

Weatherization

Weatherizing existing housing units can improve the health and safety of home environments. Weatherization (Wx) refers to modifications made to homes that insulate, control moisture, reduce air leakage, improve ventilation, and increase energy efficiency. [1,13] Examples of Wx retrofits include caulking and weather stripping around doors and windows; installing attic, wall and floor insulation; installing energy efficient appliances; installing moisture barriers on the ground beneath the dwelling, and upgrading heating, ventilation, and air conditioning (HVAC) systems.[7,3,14] These modifications can make indoor environments significantly drier and easier to heat and cool while also reducing energy use, improving air quality, and enhancing resident health and quality of life.[12]

Figure 2: Weatherizing Older Homes Improves Energy Efficiency[14]



Source: Joe Kane and Tara Pelton (2021)

Brookings Metro

> *"You feel better because of it. You know, you know your house ain't got no leaks in it. You feel you're safe. You got the carbon monoxide (detector), you know so that won't mess you up. You got the… smoke detectors in here. Yep, you feel safe… you feel good about those things."* [15]

Ventilation is an essential element of Wx. Installing insulation and reducing air leakage without adequate ventilation has been shown to reduce indoor air quality and produce negative health outcomes for residents.[13,16–18]

As the climate continues to change, extreme temperatures and weather events are expected to increase in frequency, duration, and intensity; Wx will become increasingly important.[19]

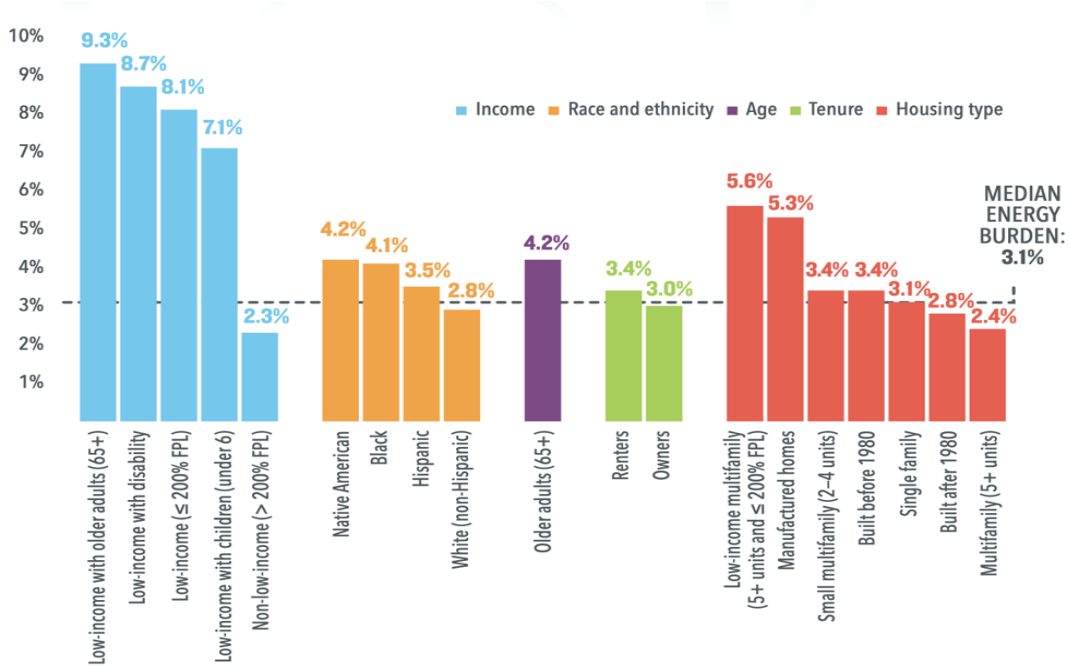
Key Takeaways

- Weatherizing existing homes can improve the physical and mental health and safety of residents. It can make indoor environments drier and easier to heat and cool; reduce household irritants, allergens, and pests; and improve energy efficiency.
- Proper installation and maintenance of ventilation systems is an essential aspect of Wx.

Energy Burden

Energy burden refers to the percentage of household income that is spent on home energy costs, like heating, cooling, and electricity. [3,4] High energy burden is defined as over 6% of household income spent on home energy bills, and severe energy burden is above 10%.[20] While the average U.S. household spends 3.1% of their household income on home energy bills, certain population subgroups experience varying levels of energy burden (Figure 3).[20] **Low-income older adults experience the highest energy burden across the United States.**[20] Additional discussion about inequities related to energy burden can be found in the Vulnerable Populations section of this document.

Figure 3: National energy burdens across subgroups (i.e. income, race and ethnicity, age, tenure, and housing type) compared to the national median energy burden[20]



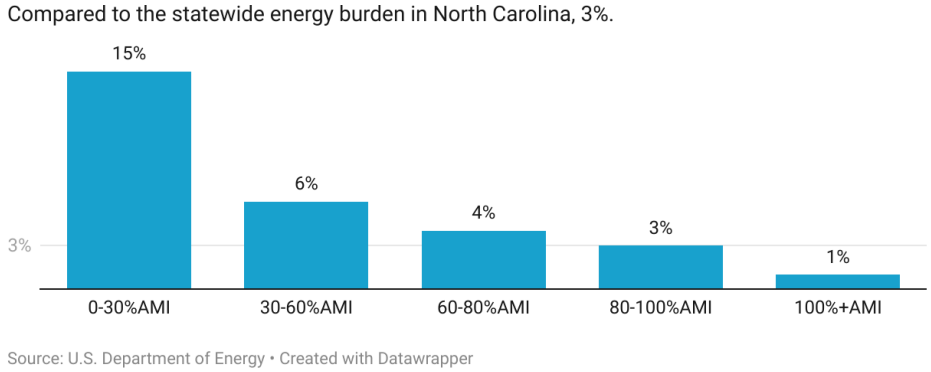
Energy Burden and Health

When a large proportion of household income is spent on energy costs, there is less income available to pay for other necessities like food and healthcare, or to invest in household maintenance, repair, or Wx.[6] This may lead to energy insecurity, or the inability to meet household energy needs. One in three households in the U.S. is energy insecure.[4] Higher energy burden is associated with poorer health outcomes, including malnutrition, mental health challenges, and iron deficiency.[4] **Wx initiatives can improve energy efficiency of homes and reduce the cost of heating and cooling homes, which would have meaningful economic and health impacts on low-income households.**

Energy Burden in North Carolina

As of 2018, the average Energy Burden for the state of NC was 3%, but energy burden varies significantly when disaggregated by AMI. Households with lower AMI experience significantly higher energy burden (Figure 4).[21]

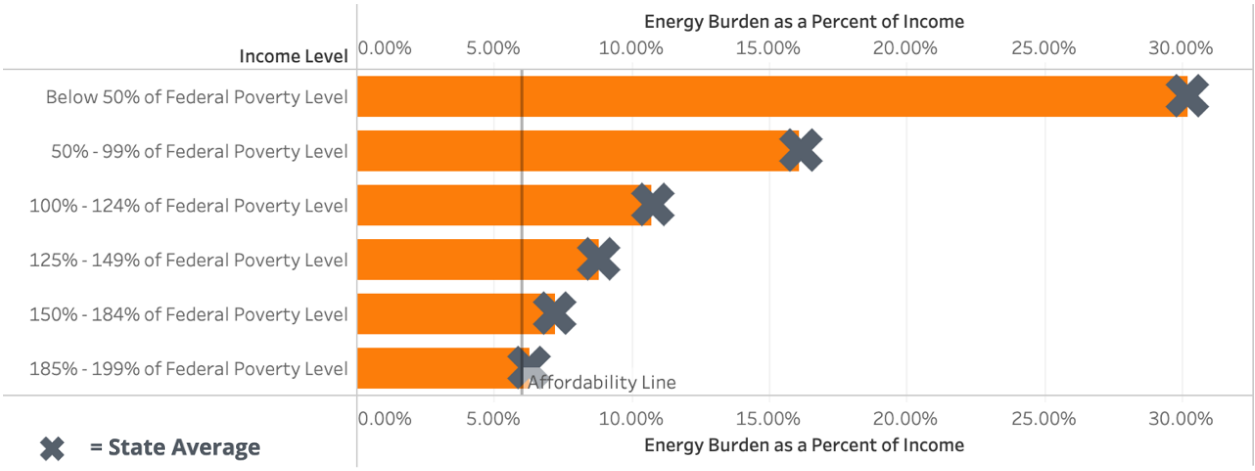
Figure 4: North Carolina Energy Burden by AMI Subgroups (2018) [21]



Energy Burden in Orange County, NC

In Orange County, the energy burden as a percent of household income are similar to the state averages. When analyzed by percent of income compared with the federal poverty level (FPL), households with lower incomes experience higher energy burden (Figure 5).[22] Findings show that **Orange County households below 50% of FPL are severely energy burdened, spending an average of 30% of their income on heating and cooling bills.**[22]

Figure 5: Energy Burden as a Percent of Income: Orange County, North Carolina (2019)[22]



Key Takeaways

- Higher energy burden is associated with poorer health outcomes.
- When a larger percentage of one's income is spent on home energy costs, fewer resources are available to spend on food, healthcare, Wx, and other necessities.
- Energy burden varies among different population subgroups, such as income, age, and race.
    - In the United States, Low-income older adults experience the highest energy burden. Native-American, Black, and Hispanic households experience higher energy burden than White households.
    - In Orange County, NC, Low-income households are severely energy burdened.

Home Environments: Health Affects and Weatherization Benefits

Home environments have a direct impact on resident health and wellbeing. Weatherization of existing housing can enhance home comfort and safety.

Cold Home Environment

Health Affects

Inadequate warmth of a home creates health challenges for residents. **Cold indoor temperatures have been shown to inflame lungs and reduce circulation, which can increase blood pressure, asthma symptoms, and poor mental health.** [13] Extreme winter temperatures can exacerbate these health morbidities and can lead to death.[13] This can be particularly severe for older adults, young children, and sick people within the residence because they have "less robust thermoregulatory systems and are also likely to spend more time inside".[12]

Weatherization Benefits

Cold indoor temperatures often result from cold outdoor temperatures and structural deficiencies within a home, such as insufficient insulation, air leaks, or lack of heating. Winter mortality is higher in areas with more temperate climates.[13] This could be because homes in regions with milder winters may not be as well insulated compared to homes in areas with harsher winters.[13]

One of the most frequently reported benefits of Wx upgrades is improved thermal comfort.[3] In dwellings that are properly insulated, there are fewer air leaks through the building envelope. Thermal insulation results in less heat loss through the building walls, floors, and ceilings, improving the efficiency of heating the house. While it is cheaper and requires less technical expertise to build homes that are not as well-ventilated or insulated, there is evidence indicating that the benefits gained from properly insulating homes outweigh the costs by a factor of up to six.[13]

Key Takeaways

- Cold home environments are associated with health morbidities such as respiratory and circulatory issues, and in some cases, death.
- Older adults, children, and people that are sick or homebound are most vulnerable to negative health impacts of inadequately heated homes.
- Wx can improve thermal comfort, reduce negative health impacts, and improve the energy efficiency of heating a home.

Hot Home Environment

Health Affects

As temperatures increase, the body has a harder time regulating its core body temperature; this can produce significant health risks.[19] High temperatures are associated with thermal discomfort, cardiovascular distress, and emergency hospitalizations.[13] **In addition to increasing risk of death, heat stress can cause serious illness such as hyperthermia, heat stroke, and heat edema**.[23] Dehydration and fatigue further compound the risk of mortality and morbidity from heat stress. [23] Increased risk of mortality from fatigue is particularly noteworthy because hot indoor temperatures at night have been shown to disrupt sleep, increase heart rate, and increase galvanic skin response (GSR).[19]

Health impacts from heat exposure depend on the body's ability to cool itself. Perspiration, or when moisture leaves the skin pores, carries heat from the body as the moisture evaporates from the skin.[24] When high air humidity is combined with high temperatures, this can greatly reduce or prevent moisture from evaporating from the skin.[24]

Weatherization Benefits

Through Wx, residents can more efficiently cool indoor temperatures and reduce relative humidity, which can reduce health morbidities and mortality attributed to heat. Because older adults and children are less adept at regulating their core body temperatures, Wx retrofits to cool indoor temperatures is particularly salient for these populations.[12]

Wx of homes through insulation and sealing of the building envelope can reduce air leakage and improve the efficiency of cooling a home. Air conditioning (AC), use of indoor fans, and effective ventilation can help facilitate home temperature regulation and cooling of body temperatures. [24] Central AC was more effective at cooling indoor home temperatures than AC window units. A study found that the "mean indoor values of temperature, vapor pressure, noise, and CO2 were significantly higher in the non-central AC residences than in the central AC residences".[19] However, AC should not be relied upon as a sole cooling strategy. AC requires energy to run, which contributes to greenhouse gas emissions, can be too expensive to run, or be unavailable for a household for other reasons.[13] While not considered Wx strategies, building design, including window placement, building materials, and presence of shade trees can be paired with home Wx to passively reduce indoor temperatures.[13]

Key Takeaways

- Hot home environments are associated with heat stress, dehydration, and poor sleep which exacerbate various health morbidities and increases risk of mortality.
- Older adults, children, and people that are sick or homebound are most vulnerable to negative health impacts of inadequately cooled homes.
- Wx can improve thermal comfort, reduce negative health impacts, and improve the energy efficiency of cooling the home.

Ventilation and Air Quality

Health Affects

Household air quality has meaningful impacts on resident health. The disease outcomes most strongly associated with air pollution are **"stroke, ischemic heart disease, chronic obstructive pulmonary disease, lung cancer, pneumonia, and cataract."**[25] In 2016, a study found that air pollution was "estimated to cause 4.2 million premature deaths worldwide."[13]

Household air quality is impacted by indoor and outdoor environments. Elements of the indoor environment that influence household air quality are the home's ventilation system, structure, lighting and heating devices, and types of furnishings, adhesives and coatings within the home.[13] For example, many building materials and furniture contain toxins like formaldehyde which, in high levels, can worsen symptoms for those with respiratory illness and irritate the eyes, nose, throat, and skin.[26] Additionally, resident behaviors such as smoking indoors and cooking can reduce indoor air quality.[13] Elements of the outdoor environment that can reduce household air quality are ambient air pollution, tobacco smoke from neighboring units, and neighborhood context.[13] In addition, the carcinogen radon is a naturally occurring radioactive gas that can accumulate in homes and other enclosed spaces.[13]

Weatherization Benefits

Weatherizing a home without installing adequate ventilation reduces indoor air quality and negatively impacts the residents' health.[13,16–18] **Ventilation and Wx must be considered together.** In the United States, the ASHRAE 62.2 ventilation standard defines the minimum ventilation requirements to minimize adverse health effects for occupants.[27] **Properly installed and maintained ventilation systems can help to reduce or expel indoor air pollutants, VOCs, and chemicals, and improve moisture balance and ventilation rates within a dwelling.** Proper ventilation **improves self-reported physical and mental health outcomes,** such as fewer headaches, eczema and skin allergies, and reduced reports of psychological distress.[28]

While ventilation is a key element of home air quality and health, the neighborhood context of a home is important to consider when installing Wx and ventilation home retrofits. High ventilation rates in "low-income urban homes may increase chronic cough, asthma, and asthma-like symptoms" for residents, which may be attributed to the infiltration of outdoor air pollutants.[29] However, high infiltration is beneficial for homes located in areas with fewer outdoor air pollutants. These mixed results highlight the importance of considering a holistic view of home health and home context when determining appropriate Wx and ventilation retrofits.

Key Takeaways

- Poor indoor air quality contributes to various negative health impacts.
- A holistic approach to Wx and ventilation must be taken to promote resident health.
- Adhering to the latest ASHRAE 62.2 ventilation standards improves health outcomes.

Vulnerable Populations

Some populations face higher risk of negative health outcomes due to unhealthy home environments. This includes older adults, children, and people with disabilities or chronic illnesses. These groups tend to spend a larger portion of their time indoors and are less adept at regulating body temperature, making them more susceptible to health hazards associated with housing conditions.[13] Additionally, **individuals with limited financial resources and increased exposure to racism are more likely to experience a higher energy burden and poorer health outcomes**.[4]

The primary focus of this analysis will be the influence of home environments and weatherization interventions on elderly individuals, low-income households, and Black communities because these populations are major recipients of OCHPC services.

Older Adults

Older adults, especially those with respiratory and cardiovascular comorbidities, are at elevated risk for mortality and morbidity from extreme temperatures and indoor air pollution.[30] The United States' population is aging. By 2030, it is projected that one in every five Americans will be 65 years or older, and the number of individuals in the 65-and-older age group will nearly double by 2060.[31] Not only are elderly people more likely to spend more time at home and are therefore more exposed to home health risks, but age is a key risk factor for heat stress.[8] People over the age of 60 sense and adapt to dehydration and regulate their core body temperature differently.[32] As the body ages, the peripheral nervous system that relays information between internal organs, extremities, and the brain, is less reliable.[23] This hinders the body's ability to feel hot or cold and "cope by adjusting heart rate, vasodilating, and sweating" or by changing their hydration behaviors.[19,23] Additionally, older adults are at higher risk for disease burden, comorbidities, decreased mobility, and polypharmacy (consuming multiple medications concurrently), all of which can further reduce a person's ability to thermoregulate. [8,17,30]

Low-income older adults experience the highest energy burden in the United States[20]

Almost 90% of seniors report wanting to stay in their homes as they age, highlighting the importance of Wx retrofits of existing homes.[19] However, older adults are much more likely to experience high (36%) and severe (19%) energy burden, as shown the Energy Burden section of this report and in Appendix A.[20] Older adults spend, on average, 4.2% of their income on home energy costs compared to the median energy burden of 3.1%.[20] For low-income older adults, the percentage of high and severe energy burdened households is even higher, and the median energy is three times higher than the national average (9.3% versus 3.1%, respectively).[20] For seniors on fixed incomes, energy burden can pose a critical barrier to aging in place and maintaining a healthy home environment. As the population ages and climate change creates more extreme weather

events, Wx will be an essential strategy to reduce energy burden and ensure home environments are healthy, safe, and comfortable for seniors.

Key Takeaways

- Older adults are more vulnerable to extreme hot and cold home environments and indoor air pollution because they are less adept at regulating their core body temperature and they are more likely to spend more time inside the home.
- Older adults are more likely to experience high energy burden; Low-income older adults experience the highest energy burden in the United States.

Low-Income Households

Income plays a significant role in determining whether a home's environment is healthy, safe, and comfortable. **Low-income households are more likely to live in housing that is older and more likely to lack insulation or be poorly built.** These housing characteristics often make it harder and more expensive to effectively heat or cool a home, resulting in larger energy burden for low-income households.[8] In the U.S., the disparity in energy burden between low-income (≤200% of the federal poverty level) and non-low-income (≥200% of the federal poverty level) households is substantial. **Low-income houses spend an average of three times more of their income on energy costs compared to households that are not considered low-income** (8.1% versus 2.3%, respectively).[20] Additionally, energy burden among low-income households is common. Among low-income households in the U.S., 67% (25.8 million) experience high energy burden and 60% (15.4 million) face severe energy burden.[20] As a result, **low-income households are more at risk of spending more of their income on energy, reducing the available income that could be spent on food, medicine, or healthcare.**

Key Takeaways

- Low-income households are more likely to live in older, poorly built, or poorly insulated homes that are more expensive and difficult to heat and cool.
- High and severe energy burden is common among low-income households.
- More money spent on home energy costs reduces income available to spend on other essentials like food, medicine, and healthcare.

Black Residents

A legacy of racist housing policies and structural racism has made it so Black families are more likely to live in older, less energy-efficient homes that may have structural deficiencies, outdated appliances, or faulty energy systems.[4] This results in a disproportionate prevalence of energy burden among Black residents across the economic spectrum.[4] "The median energy burden for Black households is 43% higher than non-Hispanic white households (4.1% versus 2.8%)".[20] As described above, there are significant physical and mental health outcomes associated with high energy burden. There is an opportunity for Wx strategies to reduce energy burden of Black households.

An additional legacy of racist housing policies is that Black people's homes are more likely than non-Hispanic white homes to be located near pollution emitting facilities. [33] When determining Wx and ventilation installation and maintenance, it is essential to consider environmental context of a home to ensure these home projects support healthy indoor air quality. This is even more important for homes in Black communities.

It is essential to recognize the historical context and policy decisions that have created this inequitable energy burden among Black households.

Housing quality, energy burden, and indoor air quality are directly linked to structural racism, which has been perpetuated through decades of disinvestment in racially segregated neighborhoods. Decades of discriminatory policies like redlining denied Black people access to mortgages and other financial resources necessary for homeownership.[4,34] Through annexation and municipal under-bounding, intentional manipulation of municipal boundaries has reduced access to essential infrastructure and services for majority Black communities across the United States. [35] Furthermore, restrictive housing covenants made it illegal for Black people to purchase homes in white neighborhoods.[36] These policies pushed many Black families into under-resourced neighborhoods with deteriorating infrastructure and poor environmental conditions and prevented wealth accumulation through homeownership.[34] Together**, racist policies have negatively impacted the health and well-being of Black families for generations.**[4,35]

Key Takeaways

- Energy burden of Black households is 43% higher than non-Hispanic white households.
- Racist policies have shaped Black homeownership, home location, home quality, access to infrastructure, and exposure to air pollution.
- Racial equity must be a key element of housing and Wx policies and programs.

Conclusion

Elderly, low-income, and Black households are more at risk of residing in homes that lack energy efficiency and weatherization, making them particularly susceptible to the adverse health impacts of poor-quality housing. When considering intersectional identities, Black, low-income seniors are more likely to live in homes that are not energy efficient or sufficiently weatherized; They are particularly vulnerable to the negative health impacts of poor-quality housing. Investing in Wx programs that are accessible, particularly for this population, can enhance the health, safety, and energy efficiency of homes in general.

Wx initiatives have the potential to address race and class disparities in energy burden and improve health for seniors, fostering greater health end economic equity and well-being within communities.

Weatherization in North Carolina

North Carolina Context

Based on the analysis above and North Carolina's current and projected population, economic, and climate characteristics, we can identify population subgroups that will benefit the most from Wx programs and investments.

Demographics

State Projections

- The population of North Carolina will reach 14.0M people by 2050.[37]
- The older adult population will grow at double the rate of North Carolina's total population. By 2029, one in five North Carolinians will be 65+ years old.[37]
- North Carolina's future population will be more racially and ethnically diverse than the population today. [37]

Orange County

- 14.4% of the population is 65+ years old.[38]
- The racial makeup of Orange County's population is 73.2% white, 11.1% Black of African American, 7.9% Asian, 5.0% two or more races, 0.6% American Indian or Alaska Native, and 2.2% other.[38]

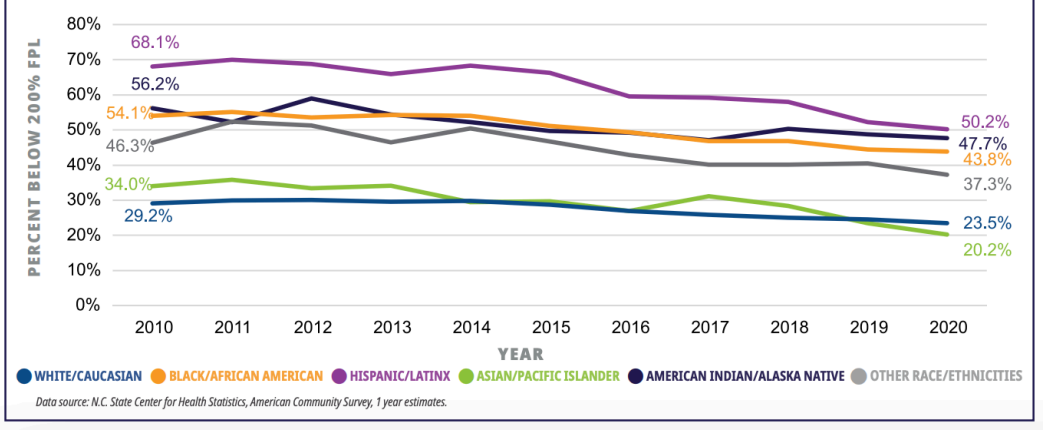
Connection to Wx

- North Carolina's population is aging and becoming more diverse, and we know older adults and households of color can benefit greatly from home Wx.

Federal Poverty Level (FPL)

North Carolina households with incomes at or below 200% FPL are often eligible for state Wx assistance. In 2017, 36.8% of North Carolinians met this criterion.[39] In 2020, this percentage was reduced to 31.0%, but racial disparities persist.[39]

Figure 6: Percent of individuals below 200% Federal Poverty Level in North Carolina by race/ethnicity (2010-2020)[39]



Connection to Wx

- 200% of the FPL is a typical threshold to be eligible for Wx assistance. Many North Carolinians are eligible for Wx, but this percentage is highest for the Hispanic/Latinx, American Indian/Alaska Native, and Black/African American populations.
    - Wx can provide the greatest benefits for these populations and help to reduce racial disparities in energy burden.

Climate

North Carolina has a relatively temperate and humid climate. Summers are very warm, and winters are moderately cold. Temperatures in North Carolina have experienced an increase of over 1 degree Fahrenheit in the 20th century, and it is anticipated that there will be unprecedented warming throughout this century. [40]

The North Carolina Climate Science Report predicts:[41]

- It is **very likely** that the number of warm (nighttime minimum temperature of 70°F or higher) and very warm (nighttime minimum temperature of 75°F or higher) nights will increase.
- It is **very likely** that summer heat index values will increase because of increases in absolute humidity.
- It is **likely** that the number of hot and very hot days will increase.
- It is **likely** that the number of cold days (daytime maximum temperature of 32°F or lower) will decrease.

Connection to Wx

- North Carolina's climate is getting hotter and more humid, and we know hot and humid home environments contribute to health morbidities and mortality.
- Wx retrofits to cool indoor temperatures and reduce relative humidity will become increasingly important as North Carolina's climate continues to change.

Conclusion

Wx will become increasingly important to the state over time to support groups most at risk for negative health outcomes due to home conditions. Wx can help North Carolina adapt to climate change and improve racial and economic equity within North Carolina. Older adults, low-income households, and Black residents benefit greatly from Wx programs.

Funding for Home Weatherization

North Carolina has a variety of programs and funding streams available to improve delivery of Wx to homes across the state. Some of these programs are locally administered for Orange County residents.

Due to data constraints, we were unable to compare the state or Orange County's weatherization budget and delivery of weatherized homes to other southeastern states or North Carolina counties.

Federal and State Funding

Essential Single-Family Rehabilitation (ESFR)

The ESFR program finances major repairs for North Carolina homeowners who are elderly or have disabilities and whose incomes are 80% or below of the median for their area.[42]

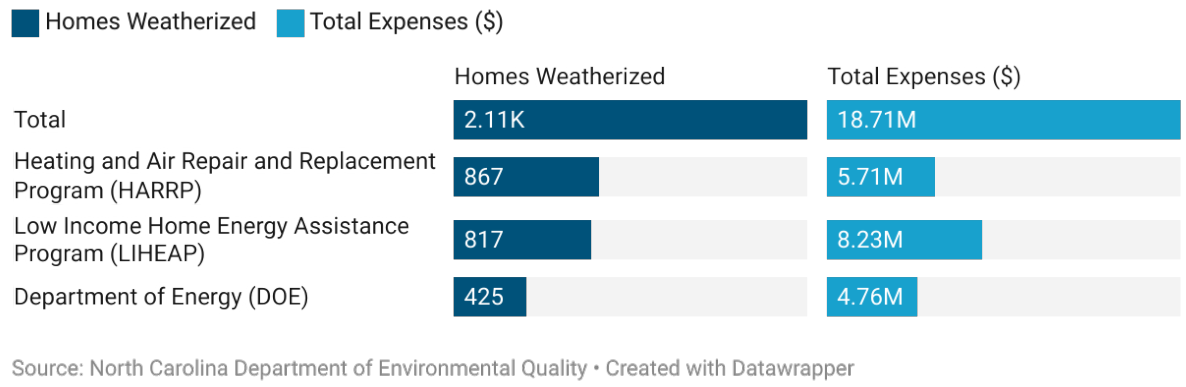
North Carolina Weatherization Assistance Program (NCWAP)

NCWAP is housed within North Carolina's State Energy Office. The program aims to help low-income people in North Carolina reduce their energy bills and keep their homes safely heated and cooled throughout the year.[43,44] It targets vulnerable populations, including seniors, people with disabilities, families with young children, high energy users, and people that are energy burdened and is funded through the federal **Low Income Home Energy Assistance Program (LIHEAP), Department of Energy (DOE) funds,** and the **Heating and Air Repair and Replacement Program (HARRP)**.[43]

Based on data received directly from the North Carolina Department of Environmental Quality, North Carolina weatherized 2,109 homes, using approximately $18.71M of the NCWAP funding in the 2021 fiscal year (Figure 7). The average amount spent on Wx for each home was ~$9k.

While the budget for and delivery of Wx through NCWAP is significant, it does not represent a complete picture of Wx activities in North Carolina or Orange County.

Figure 7: North Carolina Weatherization Assistance Program Weatherized Homes and Total Expenses (FY2021)



Urgent Repair Program (URP)

URP funds emergency home repairs for homeowners in North Carolina. Emergency repairs are considered housing conditions that threaten the resident's life or safety. The program serves older adults, are disabled, or have an income less than 50% AMI.[45]

U.S. Department of Agriculture: Section 504 Home Repair program

This program provides loans to very-low-income homeowners to repair, improve, or modernize their homes. It also provides grants to elderly very-low-income homeowners to mitigate health and safety hazards in their home environment.[46]

Orange County Funding

Orange County Climate Action Grant Program

As part of the FY19-20 budget, the Board of Orange County Commissioners created the Orange County Climate Action Fund dedicated to accelerating climate change mitigation actions in Orange County. The first round of funded projects included funding to weatherize and preserve affordable housing.[47]

Private Sector Funding

Duke Energy

Income qualified Duke Energy customers can receive Wx services.[48]

Conclusion

Key Findings

Wx and Health

- Quality of housing impacts the mental, physical, and economic health of residents.
- Higher energy burden is associated with poorer health outcomes.
- Weatherizing homes can improve health outcomes for residents by making indoor environments drier and easier to heat and cool; reducing household irritants, allergens, and pests; and improving energy efficiency.
- Some populations are more likely to live in unhealthy home environments or are more vulnerable to health risks of unhealthy home environments.
    - Older adults, low-income households, and Black residents may benefit most greatly from Wx programs in Orange County, NC.

North Carolina Context

- North Carolina's population is aging and becoming more diverse.
- 2020, 31.0% of NC households were below the 200% FPL. Within this group, racial disparities persist.
- North Carolina's climate is getting hotter and more humid.
- North Carolina households with lower % AMI experience significantly higher energy burden than households with higher % AMI.
- Wx will become increasingly important to the state over time to support groups most at risk for negative health outcomes due to home conditions, adapt to climate change, and improve racial and economic equity within North Carolina.

Funding for Home Weatherization

- In FY2021, North Carolina's Weatherization Assistance Program spent $18.71M to weatherize 2,109 homes across the state (average of $8,869 spent per household).
- North Carolina has a variety of programs and funding streams available to improve delivery of residential Wx.
- These programs typically target:
    - Households under 200% FPL
    - Households with older adults, children, or people with disabilities or chronic illnesses

Recommendations

Orange County Home Preservation Coalition

- Ensure OCHPC home repair services are equitably reaching elderly, low-income, and Black households.
- Identify strategies to enhance racial equity in OCHPC outreach.
- Evaluate how Wx and HVAC repairs are holistically evaluated and deployed.
- Identify strategies to streamline delivery of Wx and HVAC that can be modeled across the state, especially for vulnerable populations.

State of North Carolina

- Create a Weatherization Working Group (like seen in Minnesota) to assess barriers to service and establish recommendations for the North Carolina Legislature and for State WAP leaders.[5]
    - Working group members may include legislators, low-income advocates, utilities, service providers, community leaders, and others.
- Become a member of the National Association for State Community Services Programs (NASCSP) Racial Equity Work Group (REWG).[6]
- Work Areas of Interest:
    - Increase Wx funding for households of color and communities that have been historically disinvested in.
    - Increase Wx funding for households in areas with poorer air quality.
    - Increase deployment of Wx retrofits that enhance cooling and reduce relative humidity.
    - Strategically target Wx retrofits in areas of the state that are projected to experience the most extreme changes in temperature.

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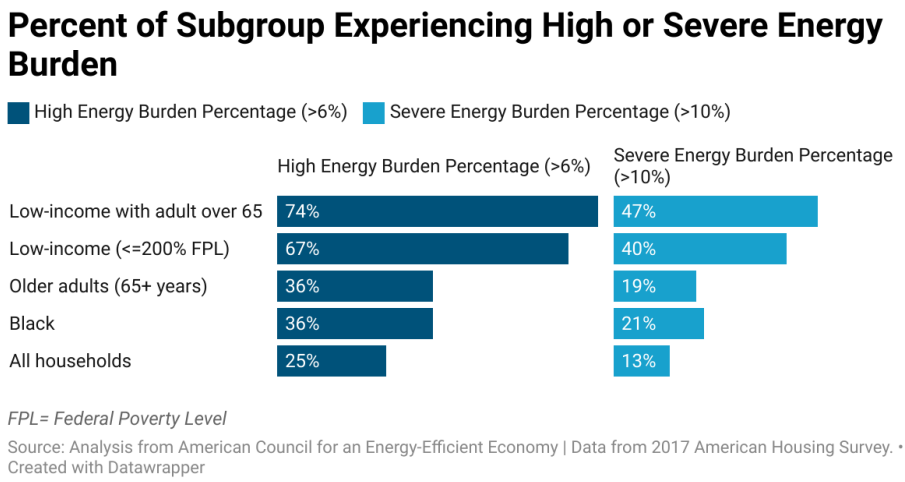
Appendix

A. Energy Burden

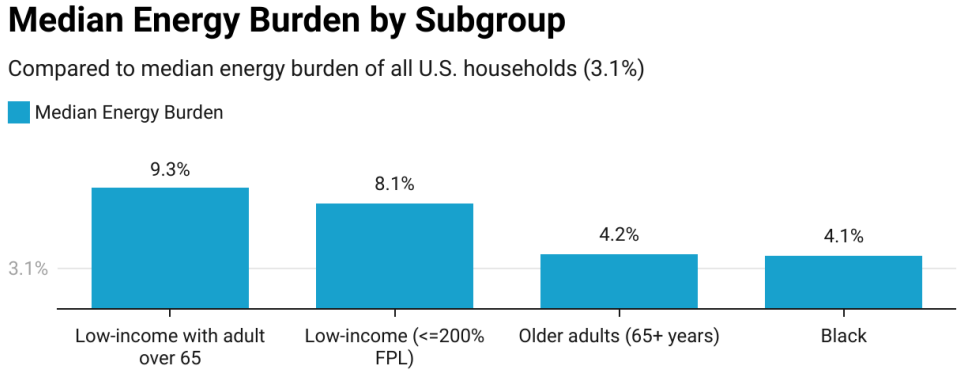
Figure A1: Percent of population subgroups in the United States experiencing high or severe energy burden



FPL= Federal Poverty Level

Source: Analysis from American Council for an Energy-Efficient Economy | Data from 2017 American Housing Survey. • Created with Datawrapper

Figure A2: Median energy burden by United States population subgroups compared to the median national energy burden of 3.1%



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