

Asthma and Weatherization in Maine

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Funding Provided by the Jessie B. Cox Foundation

January 2006

Overview

Asthma is a significant public health concern in Maine. Approximately 9% of adults in Maine and 9% of children have asthma. Asthma attacks can be triggered by certain conditions in housing that include living with moisture, mold, pests (e.g., mice, cockroaches), and dust allergens. Exposure to dust has also been shown to sensitize or cause asthma.¹

The Maine State Housing Authority in partnership with The National Center for Healthy Housing explored asthma rates among the occupants in housing units served by Maine's Weatherization program and documented moisture and mold problems, which are known housing-based asthma triggers. The goal of this effort is to better understand the moisture and mold hazards and asthma rates in households where Weatherization work occurs in order to begin a discussion on how to effectively target Weatherization and other resources to address housing based asthma triggers. This work was supported by a grant from the Jessie B. Cox Charitable Trust.

The National Center for Healthy Housing (NCHH) is a 501(c)(3) nonprofit corporation based in Columbia, Maryland dedicated to developing and promoting practical, cost-effective techniques and policies to protect children from residential environmental hazards while preserving the supply of affordable housing. Founded as the National Center for Lead-Safe Housing in 1992, NCHH conducts applied research, provides technical assistance and training, and convenes consensus process to establish best practices. It has worked with a broad array of stakeholders including federal, state, and local agencies, universities, and private research institutions and has published and contributed to nearly fifty articles and reports on environmental health and housing issues. NCHH contracted with Ellen Tohn, ERT Associates in the development of this report.

The mission of the Maine State Housing Authority (MSHA) is to assist Maine residents to obtain decent, safe, affordable housing and services suitable to their unique housing needs. MSHA's programs include, but are not limited to: first time home buyer assistance, home repair (e.g., lead, weatherization, home rehab, fuel assistance, appliance replacement), rental housing assistance, supportive housing, and homeless programs.

MSHA's Weatherization Program

MSHA administers approximately \$6.5 million dollars annually under its Weatherization and Central Heating Improvement Program (CHIP) programs. Approximately \$4.5 million dollars are allocated annually to Weatherization. The Weatherization program finances repairs for over 1,000 households annually. The goal of the program is to finance energy related repairs that increase the energy efficiency for low income

¹ Institute of Medicine (IOM). Clearing the Air: Asthma and Indoor Air Exposures, Washington DC; National Academy Press, 2000.

homeowners and renters. The programs are administered through Maine’s Community Action Program (CAP) agencies. Typical Weatherization activities include: insulation, air sealing, and in some cases safety related repairs or more general improvements. The CHIP program pays for repairs or replacement of central heating equipment. Federal Department of Energy (DOE) and Department of Health and Human Services (HHS) resources finance the Weatherization program. The average Weatherization grant is \$2,600 per housing unit.

What is Asthma

Asthma is a chronic inflammation of the airways that causes wheezing, difficulty in breathing and coughing. It is the most common chronic disease of childhood, affecting over 6 million children. It is one of the leading causes of missed school days, work absences, emergency room visits and hospitalizations.²

The Asthma Regional Council of New England (ARC) reports that 9.6% of adults in Maine currently have asthma while 14.7% of adults report having had asthma over their lifetime. The asthma rates are similar for children; 10.7% of children in Maine currently have asthma and 14.6% report having had asthma during their lifetime. Maine’s childhood asthma rates exceed those of all the other New England states. ARC relied upon the data collected as part of the National Survey of Children’s Health collected in 2003 and 2004 for the childhood estimates. The adult data were drawn from the Behavioral Risk Factor Surveillance System (BRFSS) collected in 2004. The data also demonstrate that across New England adults of lower income experienced an asthma rate that was 50% higher than adults in the highest income brackets. Children in the lowest income brackets have asthma at twice the rate as children in highest income levels.³

	Current Asthma	Lifetime Asthma
Adults	9.6%	14.7%
Children	10.7%	14.6%

Source: Asthma Regional Council of New England. The Burden of Asthma in New England, www.asthmaregionalcouncil.org, 2005.

The Maine Asthma Status Report (2002) also documents that adults in lower income households have increased asthma rates. Using data from the 1999-2000 BRFSS, this report shows that 8.6% of adults currently have asthma and 12.6% of adults report having had asthma at one point in their lifetime. Individuals in families with incomes below \$25,000 are disproportionately burdened by asthma. 11% of adults report asthma and 14.9% of adults report asthma over their lifetime, when household income is below \$25,000.⁴

² National Center for Health Statistics, Centers for Disease Control and Prevention. Asthma Prevalence, Health Care Use and Mortality, 2001-2.

³ Asthma Regional Council of New England. The Burden of Asthma in New England, www.asthmaregionalcouncil.org, 2005.

⁴ Maine Bureau of Health. Asthma Status Maine Report 2002, www.mainepublichealth.gov, 2002.

Housing conditions such as living with moisture and/or mold, pests (e.g., cockroaches and mice), dust allergens, and environmental tobacco smoke can all trigger asthma attacks.⁵

Data Collection and Analysis

Data on asthma and housing conditions were collected as part of routine Weatherization audits conducted by the CAP agencies administering the Weatherization program. The data collection was initiated by MSHA staff to better understand housing and health conditions for the families they serve. The effort was not structured to be a robust scientific project, but rather an initiative to help inform program activities. A copy of the audit form is attached. Auditors were instructed by MSHA staff to check off the box for asthma if at least one person in the household indicated they currently have asthma. Similarly, if the auditor observed any of the moisture or mold conditions listed on the audit form, they were instructed to check off the box. No additional quality control measures were undertaken as part of data collection or entry. Below we provide general descriptive statistics. No formal statistical hypothesis tests were conducted except for data presented in Tables 8 and 9. This project examined audit information collected in 2003 and 2004.

In 2003, 1103 households received weatherization assistance and 1431 households received assistance in 2004. The housing units audited by Weatherization are shown by housing type below in Table 1. Mobile homes and single-family homes dominate the data set.

Table 1: Type of Housing in 2003 and 2004

Type of housing	2003 (n=1103)	2004 (n=1431)	2003 and 2004 (n=2534)
Single Family	66%	58%	61%
Mobile Home	27%	31%	29%
Duplex	2%	3%	3%
3-4 Unit	2%	3%	3%
5 or More Units	3%	5%	4%

In both 2003 and 2004, the data indicate that at least one person in 17% of the households audited by Weatherization program reported asthma. Table 2 lists the asthma rates by type of housing. Individuals living in mobile homes and single-family homes have the highest asthma rates. These types of housing units comprise approximately 90% of the households audited by the Weatherization program.

The percentage of homes with asthma in 3-4 units buildings was not available for 2004.

Table 2: Asthma Prevalence in 2003 and 2004 by Type of Housing

Type of Housing	Percentage of Homes w/ Person	Percentage of Homes w/ Person Reporting	Percentage of Homes w/Person Reporting
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⁵ Institute of Medicine (IOM). Clearing the Air: Asthma and Indoor Air Exposures, Washington DC; National Academy Press, 2000.

	Reporting Having Asthma 2003 (n=1103)	Having Asthma 2004 (n=1382)	Having Asthma 2003 and 2004 (n=2485)
Single Family	16%	19%	18%
Mobile Home	22%	18%	19%
Duplex	10%	2%	4%
3-4 Unit	4%	--*	--*
5 or More Units	12%	6%	8%
All	17%	17%	17%

* Data were not available on occupant asthma in the 3-4 unit buildings audited in 2004.

Living in homes with moisture and/or mold problems has been shown to trigger asthma attacks and is associated with increased respiratory problems.⁶⁷ Dirt floors, lack of bathroom and kitchen vents, lack of dryer vents are the most commonly cited moisture issues in the Maine Weatherization units. A second tier of frequently cited moisture problems include: roof leaks, water staining, and failed sump pumps (Table 3). At least one moisture issue was observed in 75% of all households.

Table 3: Moisture Issues in 2003 and 2004 (n=2534)

Rank	Moisture Issue	Percent of Homes*
1	Dirt Floor	33%
2	Bathroom Vent	24%
3	Kitchen Vent	23%
4	Dryer Not Vented	16%
5	Roof Leaks	10%
6	Water Staining	10%
7	Sump Pump	10%
8	Other Moisture	9%
9	Clothes Drying	9%
10	Firewood	8%
11	Standing Water	7%
12	Gutters	5%
13	Humidifier Use	5%
14	Plumbing Leaks	4%
15	Aquarium	3%
16	Sill Rot	3%
17	Efflorescence	2%
18	Un-vented Space Heater	2%
Any Moisture Issue		75%

*Moisture issues are not mutually exclusive; table cannot be summed

The most frequently cited locations for mold and mildew were crawlspaces, bathroom, basements, and windows (Table 4). Table 5 presents the average numbers of moisture and mold/mildew issues. Single family and mobile homes have the highest average moisture issues (2.5 and 2.4). However, this observation may be an artifact of the data

⁶ Institute of Medicine (IOM). Clearing the Air: Asthma and Indoor Air Exposures, Washington DC; National Academy Press, 2000.

⁷ IOM. Damp Indoor Spaces, Washington, DC; National Academy Press, 2004.

that are dominated by these two types of housing units. It is interesting to note that 3-4 unit buildings have the highest average mold/mildew issues (3.2), however, these results represent only one year of data and a small number of buildings. Mobile homes have more moisture or mold/mildew issues (27%) than other housing types (See Table 6). Mobile homes reported more mold and mildew in crawl spaces at a greater percentage than any other type of housing (See Table 7). Nineteen percent of mobile homes experienced mold and moisture in crawl space.

Table 4: Mold/Mildew Locations in 2003 and 2004 (n=2534)

Rank	Location	Percent
1	Crawlspace	9.9%
2	Bathroom	6.5%
3	Basement	6.0%
4	Windows	5.5%
5	Ceiling	2.0%
6	Kitchen	1.5%
7	Walls	1.4%
8	Other Mold	1.3%
9	Attic	0.7%
10	Closets	0.5%
Any Location		24.5%

Table 5: Average Number of Moisture and Mold/Mildew Issues by Type of Housing (n=2534)

Type of housing	Average Number of Moisture Issues	Average Number of Mold/Mildew Issues
Single Family	2.5	1.4
Mobile Home	2.4	1.4
Duplex	1.9	1.4
3-4 Unit	1.9	3.2
5 or More Units	1.1	1.5

Table 6: Percent of Homes with Moisture or Mold/Mildew Issues by Type of Housing

Type of housing	Percent in 2003 (n=1103)	Percent in 2004 (n=1431)	Percent in 2003 and 2004 (n=2534)
Single Family	22%	23%	23%
Mobile Home	26%	27%	27%
Duplex	5%	10%	9%
3-4 Unit	9%	12%	11%
5 or More Units	39%	1%	14%

Table 7: Locations of Mold/Mildew Issues in 2003 and 2004 by Type of Housing

	Single Family	Mobile Home	Duplex	Apt. (3-4)	Multi (5+)
Crawlspace	6%	19%	1%	3%	7%
Basement	9%	1%	4%	3%	2%
Bathroom	7%	6%	6%	7%	0%
Kitchen	2%	1%	0%	4%	1%
Attic	1%	0%	0%	0%	0%
Windows	6%	5%	7%	6%	3%
Closets	0%	1%	0%	6%	0%
Ceiling	2%	2%	0%	6%	0%
Walls	1%	2%	0%	7%	0%
Other Mold	2%	1%	0%	1%	3%
Any Place	24%	29%	10%	11%	14%

Table 8: Number of Units with Asthma and Moisture/Mold/Mildew Issues in 2003 and 2004

Asthma	Moisture/Mold/Mildew		Number of Units	Percent of Units
	Yes	No		
Yes	389	41	430	15%
No	1519	854	2373	85%
<i>Number of Units</i>	1908	895	2803	
<i>Percent of Units</i>	68%	32%		

Fifteen percent of the homes had a resident with asthma. Sixty-eight percent of homes had moisture/mold issues (see Table 8). There is a significant association between moisture/mold and asthma (Chi-squared test p-value<0.001).

In 20.4% of homes with moisture/mold issues, a resident reported asthma. In 4.6% of homes without moisture/mold issues, a resident reported asthma. Thus a home with a moisture/mold issue is 335% more likely to have a resident with asthma than a home without moisture/mold issues.

Table 9: Number of Units with Asthma/Bronchitis and Moisture/Mold/Mildew Issues in 2003 and 2004

Asthma/Bronchitis	Moisture/Mold/Mildew		Number of Units	Percent of Units
	Yes	No		
Yes	497	50	547	17%
No	1769	877	2646	83%
<i>Number of Units</i>	2266	927	3193	
<i>Percent of Units</i>	71%	29%		

Seventeen percent of the homes had a resident with asthma/bronchitis. Seventy-one percent of homes had moisture/mold issues (see Table 9). There is a significant association between moisture/mold and asthma/bronchitis (Chi-squared test p-value<0.001).

In 21.9% of homes with moisture/mold issues, a resident reported asthma/bronchitis. In 5.4% of homes without moisture/mold issues, a resident reported asthma/bronchitis. Thus a home with a moisture/mold issue is 407% more likely to have a resident with asthma/bronchitis than a home without moisture/mold issues.

In reviewing the above results, it is important to note that the total number of units for 2003 and 2004 presented in the Tables 8 and 9 do not match the totals presented in earlier tables. The total shown in Tables 8 is 2803 which is higher than the 2534 units reported in Table 1. The total for the asthma and/or bronchitis analysis is 3191 (Table 9) which is also higher than total units of 2534 reported in Table 1. It has not been possible to identify any double counting of units and hence the conclusions drawn on the association between moisture/mildew/mold and asthma as well as moisture/mold and asthma/bronchitis should be treated as preliminary. However, it appears that the relationship between asthma and moisture/mold issues is so strong that correction of these numbers would still likely yield significant relationships between asthma or asthma/bronchitis and moisture/mildew/mold issue.

Conclusions

Asthma is a significant health concern among the occupants of units treated by the Maine Weatherization program. Roughly 1 out of every 6th home (17%) treated by the Weatherization program is occupied by at least one person with asthma. These results are consistent with other studies of asthma in Maine that show current asthma rates among adults in lower income households at 11% and that 14.9% of lower income adults report having asthma during their lifetime. There are no comparable state data on asthma rates by household to which we can compare the results from this study. However, it is clear that a high proportion of units in the Weatherization program are occupied by asthmatics.

The data also indicate that Weatherization units have substantial moisture problems, which is a known asthma trigger. Moisture problems were most frequently observed around dirt floors and in bathrooms, kitchen and around dryers with poor ventilation. Mold and mildew were most frequently observed in crawl spaces, bathroom, basements, and along windows. These data strongly suggest that below grade spaces, sources of high humidity such as improperly vented bathrooms, kitchens and dryers are likely contributing to the bulk of moisture and mold problems in this group of housing units. The moisture and mold problems are most significant in mobile homes and single family homes which dominant the data set.

Despite some inconsistencies in the data, it appears that living in a home with either moisture or moisture and mold substantially increases the likelihood that someone in the home will report asthma or asthma/bronchitis.

Recommendations

1. **Improve coordination among housing and health providers to deliver more effective services to families struggling with asthma.** Establish a working group comprised of MSHA housing staff and key health officials and providers to identify how to more effectively assess asthma among occupants in units undergoing housing repairs, target housing repairs to address asthma triggers, provide health education to occupants, and track improvements in health status and related questions.
2. **Explore creating a Weatherization triage system to track and treat units where an occupant reports asthma differently than other housing units.** The system might include:
 - 2.1. Ask an initial intake question about asthma to track “asthma units” differently before the audit occurs.
 - 2.2. Construct a tailored audit for asthma units to look more aggressively for asthma triggers (e.g., moisture/mold, pest, poor ventilation, allergens).
 - 2.3. Identify key housing repairs that can reduce asthma triggers and prioritize these repairs in “asthma units”.
 - 2.4. Develop a referral system between the Weatherization program and other MSHA home repair programs that anticipates a flow of “asthma Weatherization units” being eligible for added home repair funding.
 - 2.5. Develop a referral system with health providers who can offer asthma education to residents and/or train CAP agency staff to perform educational visits.
3. **Improve data collection and analysis related to occupant health and housing-based health hazards in the Weatherization program.**
 - 3.1. Modify the Weatherization audit question on asthma to be consistent with other state data collection queries on asthma. Consider using the BRFSS survey questions. Provide more explicit training to auditors in how to implement the audit questions related to health and housing-based health conditions.
 - 3.2. Focus and streamline questions to provide a clear baseline on health status and key asthma triggers to enable follow up surveying to document changes due to Weatherization.
 - 3.3. Develop a robust and accessible data management system to track asthma among the population served by Weatherization.

4. **Review and modify where needed current MSHA Weatherization construction specifications to prioritize repairs to address the most common moisture, mold and mildew problems and other asthma triggers.**
 - 4.1. Ensure the Weatherization construction guidance has appropriate information on how to address common moisture and mold problems.
 - 4.2. Provide additional training to Weatherization staff and contractors on repairing/addressing moisture and other asthma triggers.
5. **Explore expanding changes in unit assessment/audits, surveying of occupant health status, and modifications in construction practices to address asthma triggers and other health issues *beyond the Weatherization program to other MSHA housing repair programs.***
 - 5.1. Consider development of a common unit assessment tool that can be used in **all** MSHA housing repair programs to document asthma and asthma triggers (moisture, mold, pests, and allergen sinks) prior to housing repairs and after work is completed. The results of such assessments could be used to identify high priority repairs in the homes of asthmatics.
 - 5.2. Review construction and design specifications to address the most common moisture/mold issues, pest problems and other asthma triggers.
 - 5.3. Help coordinate referral to asthma educators.
 - 5.4. Evaluate changes in health status and/or environmental asthma triggers following housing repairs funded by MSHA.