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New Jersey In-home Asthma Intervention Pilot Project - Evaluation Findings

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Health Resources in Action
Advancing Public Health and Medical Research

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Executive Summary

Project Background - As of 2019, the Centers for Disease Control and Prevention estimated that 7% of all children under the age of 18 in the US had asthma, slightly lower than the prevalence rate of the previous year. However, asthma remained more prevalent among Black, non-Hispanic (13.5%), American Indian/Alaskan Native (5.2%), multi-racial (11.2%) and Hispanic (7.5%) children. These estimates translate to over 5.1 million children with asthma, over half of whom are Black or Hispanic.

In 2016, the Nicholson Foundation undertook the **New Jersey In-home Asthma Intervention Pilot Project** with the goal of improving asthma outcomes and reducing healthcare costs among children aged 2-17 years who were enrolled in New Jersey FamilyCare (i.e., Medicaid). The project sought to replicate and deliver an evidence-based, Community Health Worker (CHW)-led in-home asthma intervention to support caregivers in the management of their asthmatic child's symptoms. Four grantee provider sites were selected to receive funding to implement the model.

Each grantee used a variety of methods to reach and recruit participant families, however the intervention model was the same, including three home visits conducted over two to three months and one follow-up phone call conducted approximately six months after the final home visit. The intervention employed CHW(s) and a clinical supervisor and provided asthma management education; review of the patient's asthma action plan and medications; referrals to providers or social services; delivery and demonstration of required environmental asthma management supplies (e.g., HEPA filter vacuum cleaner with low ozone emissions, dust-mite-proof mattress and pillow encasements, pest management supplies, "green" cleaning supplies, etc.) to each family.

Evaluation Methods - Heath Resources in Action (HRiA) was engaged to develop and conduct an evaluation that assessed changes in pediatric patients' asthma control and the presence of environmental asthma triggers in the home. Evaluation data was collected by each grantee as part of the in-home intervention delivered by the CHW's during home visit 1 and 3. An additional evaluation follow-up phone call was conducted by the CHW approximately six-months after home visit 3.

Data from the four provider sites were aggregated for analyses. Only enrolled caregivers/children with complete evaluation data for both home visit 1 and home visit 3 were retained in final analyses (n=161). Statistical analyses were conducted using paired t-tests and McNemar's tests to compare asthma control scores, quality of life indicators, and environmental composite scores across timepoints.

Evaluation Findings -

Enrollment and Demographics: Of the 161 enrolled families with complete evaluation data, the majority of index children were either Hispanic/Latino (53.4%) or Black/African American (41.6%) and the majority were between the ages of 4 and 11 years old (64.6%). While most caregivers spoke English at home (70.2%), over one-third spoke Spanish (41.0%). The educational attainment of caregivers ranged with about a third having completed high school (36.0%) and slightly more reporting at least some college or vocational training (39.8%). Household composition data showed that 35.4% of families had at least one other child in the home with asthma, in addition to the index child, and 39.8% of families had at least one adult in the home with asthma.

Improvement in Asthma Management: At home visit 1, less than one third of caregivers (30.4%) were able to provide a written Asthma Action Plan for their index child to the CHW for confirmation. This proportion increased significantly to 69.6% by visit 3 ($p<0.001$). Caregiver reported use of written Asthma Action Plans also increased significantly over the course of the intervention, from 30.4% at visit 1 to 69.6% at visit 3 ($p<0.001$). These significant improvements were observed among both Hispanic/Latino and Black/African American children in stratified analyses.

Reduction in Environmental Triggers: The environmental assessment data indicated many homes had significant asthma triggers present at visit 1. For example, the majority of caregivers reported the use of cleaning products containing bleach or ammonia (79.5%) or air fresheners, scented candles, or incense (64.0%) in the home. At visit 3, the presence/use of each of these in the home had declined significantly ($p < 0.05$) and overall asthma environment trigger composite score which were computed based on all environmental questions and CHW room observation checklists, were significantly reduced between visit 1 and visit 3 as well. Each of these significant improvements was observed among both Hispanic/Latino and Black/African American children in stratified analyses.

Improvement in Asthma Control: CHWs administered a validated asthma control scale that was appropriate for the index child's age to assess asthma control. At visit 1, approximately one quarter of index children (26.7%) were experiencing controlled asthma based on this screening. This increased significantly to 44.7% of index children at visit 3 ($p < 0.001$). In stratified analyses, this improvement was similarly observed among Hispanic/Latino children (29.1% vs. 46.5%, $p < 0.01$) and Black/African American children (23.9% v. 44.8%, $p < 0.01$). Further analyses also showed that asthma control significantly improved for children in families where the caregiver had either a confirmed asthma action plan and/or a decrease in the overall environmental composite score at visit 3 ($p < 0.05$); whereas no improvement in asthma control was observed among families with neither a confirmed asthma action plan nor a decrease in overall environmental composite score at visit 3.

Evaluation Follow-up Data: The sustained impact of the CHW-led intervention was explored as part of the evaluation follow-up. However, after the home-visit portion of the pilot was completed, many caregivers were lost to follow-up. Therefore, these exploratory analyses were limited to caregivers who had elected to complete that data collection timepoint ($n=86$). Within this sub-group, the number of missed days of work/school (for caregivers) and number of missed days of school/childcare (for index children) both declined significantly between visit 1 and follow-up. There was a median decline of 2.5 missed days among caregivers and a median decline of 4 missed days among index children. Exploration of the evaluation follow-up data further suggested that the significant improvements noted between visit 1 and visit 3 were generally sustained through the follow-up timepoint, with some additional gains in asthma control post-visit 3, particularly among index children in the youngest age group (under 4 years).

Discussion: Data indicate that caregivers enrolled in this CHW-led in-home asthma intervention were able to successfully adopt the key asthma management skills and behaviors that were targeted. Furthermore, index children experienced significantly improved asthma control. Findings suggested that the intervention was successful in improving the health and wellbeing of children with poorly controlled asthma, as well as environmental conditions in the home. Importantly, this pilot was conducted entirely with families served by Medicaid and who primarily identified as Hispanic/Latino and Black/African American. The positive findings of the pilot suggest that the intervention components and educational content were designed to be relevant and valuable to these target populations and the intervention may be a useful approach to mitigating economic, racial, and ethnic health disparities in asthma among children. The intervention offers great potential for a broader population impact if the program can be sustained and replicated to reach more Medicaid families at more provider sites. Further evaluation is progress to assess the impact of the Pilot on healthcare utilization and costs among index children.

Background

As of 2019, the Centers for Disease Control and Prevention (CDC)¹ estimated that 7.0% of all children under the age of 18 in the United States had asthma, which was slightly lower than the prevalence rate of the previous year. However, asthma remained more prevalent among Black, non-Hispanic (13.5%), American Indian/Alaskan Native (5.2%), multi-racial (11.2%) and Hispanic (7.5%) children compared to White, non-Hispanic (6.4%) or Asian (3.7%) children. These prevalence estimates translate to over 5.1 million children with asthma in the US, over half of whom are either Black or Hispanic.

Data by age group suggest that asthma prevalence increases slightly through early childhood and peaks during the young teenage years (2.6% age 0-4 years; 8.3% age 5-11 years; 10.8% 12-14 years; and 7.0% 15-17 years), although the proportion of those whose asthma is uncontrolled has been shown to decline with age (59.1% age 0-4 years; 54.0% age 5-11 years; and 43.2% age 12-17 years)². Unmanaged pediatric asthma has been shown to be a heavy burden on the healthcare system as well as on patients and their families. Among all children under 18 years, the 2018 rate of asthma-related hospital inpatient stays was 10.1 stays per 10,000 and the rate of asthma-related Emergency Department visits was 104.7 visits per 10,000.³ Rates of both are known to be higher among younger children as well as among low-income and black, Indigenous and people of color populations.

One comprehensive study based on data from 2008 through 2013 estimated that the total cost of pediatric asthma in the United States was \$5.92 billion with per child costs ranging from \$3,076 to \$13,612⁴. Though more current cost data are not available, the high healthcare costs related to poorly controlled asthma likely remains high. In 2019, the CDC estimated that over 700,000 Emergency Department visits and over 70,000 Hospitalizations related to asthma had occurred among children.⁵

Beyond higher healthcare utilization and cost, when a child's asthma is left uncontrolled, there can be detrimental health consequences for the child later in life⁶, including impacts in physical as well as social and emotional health. However, control of asthma takes intensive attention, and for children it is crucial that caregivers are well-equipped to help manage their child's asthma.⁷ Caregivers must understand and support the appropriate use of asthma medications for their child, they must learn when and how to respond to worsening asthma symptoms, and they must be able to identify and mitigate exposure to asthma triggers within the home.

The National Asthma Education and Prevention Program (NAEPP) has set forth guidelines that recommend providers prepare and present every asthmatic patient with a written asthma plan, which

¹ Centers for Disease Control and Prevention. Most Recent National Asthma Data [Internet]. 2021. Available from: https://www.cdc.gov/asthma/most_recent_national_asthma_data.htm

² https://www.cdc.gov/asthma/asthma_stats/uncontrolled-asthma-children.htm

³ Centers for Disease Control and Prevention. Most Recent National Asthma Data [Internet]. 2021. Available from: https://www.cdc.gov/asthma/most_recent_national_asthma_data.htm

⁴ Perry R, Braileanu G, Palmer T, Stevens P. The Economic Burden of Pediatric Asthma in the United States: Literature Review of Current Evidence. *Pharmacoeconomics*. 2019;37(2):155–67.

⁵ Centers for Disease Control and Prevention. Most Recent National Asthma Data [Internet]. 2021. Available from: https://www.cdc.gov/asthma/most_recent_national_asthma_data.htm

⁶ Gustafsson PM, Watson L, Davis KJ, Rabe KF. Poor asthma control in children: Evidence from epidemiological surveys and implications for clinical practice. *Int J Clin Pract*. 2006;60(3):321–34

⁷ Clark NM, Mitchell HE, Rand CS. Effectiveness of educational and behavioral asthma interventions. *Pediatrics*. 2009;123.

includes guidance on avoiding asthma triggers, appropriate medications for different circumstances, how to recognize and treat worsening conditions, and when to seek medical attention. However, if use of the action plan is not emphasized by the provider, if the caregiver and/or patient does not use it or does not know how to, and/or if no measures are taken to reduce the presence of asthma triggers in the home, such clinical guidance may have little impact.

Over the years, there has been research and discussion around the use of in-home family education interventions to support caregivers in the management of their children's asthma and to reduce healthcare utilization (e.g., urgent care visits, hospitalizations). Often these models include CHWs and/or nurses who visit the homes of families to provide them with education, resources, and support. There has been some promising evidence for the effectiveness of these CHW-led programs in improving children's asthma control, and studies of such interventions have shown that these programs can be successful in lowering asthma related urgent care visits and/or hospitalizations and improving the quality of life for children⁽¹⁰⁻¹³⁾ and reductions in children's asthma symptomatic days⁽¹⁵⁾.

In 2016, the Nicholson Foundation undertook the **NJ In-home Asthma Intervention Pilot Project** with the goal of improving asthma outcomes and reducing healthcare costs among children aged 2-17 years who were enrolled in New Jersey FamilyCare (i.e., Medicaid). The project specifically sought to replicate and deliver a specific evidence-based, CHW-led asthma intervention home-based to support caregivers in the management of their asthmatic children's symptoms.

The setting for the project is particularly notable. State level data from 2018 suggest that the burden of asthma may be higher for children living in New Jersey compared to other states. Overall, 9.1% of NJ children under 18 years are estimated to currently have asthma⁸ (vs. 7.0% national average). Furthermore, the racial/ethnic disparities were particularly evident among young children in NJ – in 2018 Black, non-Hispanic children aged 4 years and younger have rates of asthma hospitalizations and ED visits that are four to five times higher than among white, non-Hispanic children in the same age group.⁹ Thus, the intervention activities had the potential to impact a particularly vulnerable population of children, while also contributing to the literature evaluating the impact and effectiveness of CHW-led interventions in the home.

Ultimately, provider organizations/coalitions were selected by the Nicholson Foundation to receive funding to implement their in-home models and to participate in an over-arching evaluation to track the impact of their work - **Health Coalition of Passaic County, Rutgers School of Nursing and Rutgers NJ Medical School Department of Pediatrics (delivered by the Newark Community Health Center), Jersey Shore University Medical Center, and Henry J. Austin Health Center**. Health Resources in Action (HRiA) was engaged to develop and conduct an evaluation that assessed changes in pediatric patients' asthma control and the presence of environmental asthma triggers in the home across grantees. This report summarizes the key findings from this evaluation.

⁸ <https://www.cdc.gov/asthma/data-visualizations/default.htm>

⁹ Uniform Billing Patient Summary, Division of Health Care Quality and Assessment, New Jersey Department of Health, <http://www.nj.gov/health/healthcarequality/health-care-professionals/niddcs/>

Intervention Model

Target Population

Each grantee used a variety of methods to reach and recruit their participant families, however the inclusion and exclusion criteria were identical across all four grantee partnerships. In order to participate, a child had to have poorly controlled asthma as evidenced by either two or more asthma-related ED treat-and-release visits in the prior 12-months (including observational stays) or one asthma-related inpatient hospitalizations in the prior 12-months. The enrolled child also had to be between 2 and 17 years of age and be a current recipient of NJ FamilyCare (i.e., Medicaid). Even when an identified child met the inclusion criteria, they were excluded from participation if they had no previous diagnosis of asthma prior to the asthma-related ED visits (i.e., this was a child's first presentation of asthma), had other medical conditions that affect breathing, such as poorly controlled sickle cell disease or cystic fibrosis, was currently participating in an in-home asthma intervention or has participated in one within the past 12 months, or was homeless (e.g., living in a motel or homeless shelter).

In-Home Activities

While only one child per household was technically eligible for enrollment, the intervention was delivered at the household level. The in-home asthma intervention that The Nicholson Foundation sought to replicate was a modification of Krieger's pediatric asthma care model, which was one of the interventions used by the New England Asthma Innovations Collaborative (NEAIC)¹⁰, funded by the Centers for Medicare and Medicaid Services. It includes three home visits conducted over two to three months and one follow-up phone call conducted approximately six months after the final home visit. The intervention is predicated on a staffing model that employs a CHW and a clinical supervisor and includes the following activities/materials during the home visit. It is important to note that the COVID-19 pandemic began in late March 2020 which necessitated changes to intervention delivery in the final months of the implementation periods (see Challenges and Limitation section for more detail).

- **Home Visit 1:** Conducted by the CHW; delivers specific asthma management education to the patient's caregiver(s); includes reviewing the patient's asthma action plan and medications with the caregiver; provides referrals to healthcare providers or social services, as needed.
- **Home Visit 2:** Conducted by the CHW approximately two weeks after their first visit; delivers, and if needed, demonstrates the use of the following required environmental asthma management supplies: one High-Efficiency Particulate Air (HEPA) filter vacuum cleaner with low ozone emissions (and bags if required by model), one dust-mite-proof mattress encasement in the size required for the patient's sleeping area, dust-mite-proof pillow encasement(s) for the patient's sleeping area, pest management supplies (e.g., gel bait traps, sticky traps, and food containers, covered trash-can), "green" cleaning supplies, and other optional supplies such as an air conditioner and air filters.; reinforces and provides additional asthma management education to the patient's caregiver(s) as necessary.
- **Home Visit 3:** Conducted by the CHW approximately four to six weeks after their second home visit; reinforces and provides additional asthma management education with patient's caregiver(s) as necessary.

¹⁰ <https://asthmaregionalcouncil.org/our-work/neaic/>

Evaluation Methodology

Each of the four grantees was responsible for recruiting, consenting, enrolling, and collecting evaluation data from their own participants. This included the process of obtaining IRB approval from their respective institution before enrollment and implementation of their intervention began. Each program ensured that the caregiver provided consent for their own participation and permission for their child's participation in the evaluation. HRiA provided extensive technical assistance and training support to the implementation staff of each grantee to ensure the consistent administration of evaluation data collection instruments across sites.

Data Collection

Evaluation data collection occurred as part of the in-home intervention activities delivered by the CHW's during home visit 1 and home visit 3. One additional evaluation focused follow-up phone call was also conducted by the CHW approximately six-months after home visit 3. The same set of data collection instruments were administered at each timepoint and included:

- **Caregiver questionnaire:** This questionnaire was developed to assess different dimensions of asthma control as well as quality of life. The tool begins with a set of demographic questions pertaining to the enrolled child (gender, age, race, Hispanic ethnicity, language spoken at home) and includes questions on the caregiver's educational attainment and their relationship to the index child. Additional questions pertain to the caregiver's knowledge and use of an Asthma Action Plan for the enrolled child, the number of days of work or school missed by caregiver due to enrolled child's asthma in the prior 6 months, the number of days of school or childcare missed by enrolled child due to child's asthma in the prior 6 months, and whether the enrolled child had received a flu shot in the prior 12 months. Several questions pertaining to household composition were also included which identified whether other children or adults in household also had Asthma.
- **Asthma control scale:** This is a validated scale to assess the degree of asthma control in the enrolled child. Three different validated asthma scales were included in the questionnaire and the CHW administered the appropriate scale based upon the age of the enrolled child (the **Test for Respiratory and Asthma Control in Kids** (TRACK) for children under 4 years, the **Childhood Asthma Control Test** (Childhood ACT) for children between 4 and 11 years, and the **Asthma Control Test** (ACT) for children aged 12 years and older).
- **Environmental assessment:** To assess the presence of environmental asthma triggers in the home, the environmental assessment instrument included questions to the caregiver, as well as observations by the CHW. There were seven caregiver questions which pertained to the presence of tobacco smoke in and around the home or building, presence of mold or musty odors in the home, presence of furry or feathered pets in the home, presence of pests (e.g., cockroaches, mice, or rats) in the home, and use/presence of specific chemical irritants (e.g., cleaning products with bleach or ammonia, paint products, air fresheners, etc.) in the home. The environmental assessment also included an observation checklist for each of four rooms in the home (living room, kitchen, index child's bedroom and bathroom) that was completed by the CHW. The same nine observation items were included in the checklist for each room. These items included the presence of dust on surfaces, evidence of water damage or leaks, evidence of mold or mildew, evidence of pests, evidence of tobacco use, and presence of other odors.

Data Analyses

The evaluation of the NJ In-home Asthma Intervention Pilot was designed to capture the same data indicators and outcome measures by each of the four grantees in order to allow for the data to be

aggregated across sites, increasing the statistical power to detect significant change in final analyses. A secure, online data collection system was developed and made available to all grantees, into which the CHWs submitted the completed evaluation data to HRiA for analyses. During the active implementation period, data were checked quarterly for accuracy and completeness. Interim data summaries were regularly shared back with the partnerships for their own use in programmatic and data related quality improvement activities.

Data from the four provider sites were aggregated and analyzed using R statistical package (R Core Team, 2020). Among all participating, only enrolled caregivers/children with complete evaluation data for both home visit 1 and home visit 3 were retained for final analyses. Statistical analyses were conducted using paired t-tests and McNemar's tests to compare asthma control scores, quality of life indicators, and environmental composite scores across timepoints, pre- and post-intervention. Sub-group analyses (e.g., age, race/ethnicity, etc.) were explored to identify groups or populations that may have experienced greater/lesser impact from the intervention. Because loss-to follow-up was higher for the phone follow-up, data from this timepoint were only in exploratory analyses to better understand whether any observed change was sustained in the longer term.

Challenges and Limitations

As with all data collection efforts, there are limitations that should be acknowledged. First, the project was a pilot designed to better understand and describe the potential impact in-home asthma education models may have among vulnerable and high-risk populations. As such, grantees sought to engage as many eligible families as possible to participate, however outreach and enrollment of families was challenging for most grantees. Some grantees found caregivers to be fearful of in-home visits, particularly those with concerns related to immigration status. Other grantees encountered challenges around a lack of referrals to the program from EDs or physicians' offices. And over the course of implementation, two grantees ceased implementation due to operational issues around staffing and funding at the clinical site.

Furthermore, because participation in the pilot required families to provide informed consent, which included the sharing the index child's de-identified Medicaid data with researchers, all grantees encountered challenges in meeting their original outreach and enrollment goals. Thus, the final sample size is relatively low which may have limited our ability to detect statistically significance differences in some analyses. Additionally, once the CHW-led home visits were completed (i.e., after all elements of intervention activities had been delivered), a number of families were lost to follow-up, preventing more complete analyses of data collected during the evaluation follow-up phone call.

Most notably, the final eight months of the implementation phase of the project took place during the COVID-19 pandemic in the United States. All home visits halted on March 13, 2020, the intervention could be redesigned to be delivered virtually, systems were put into place, and IRB applications were submitted and approved in May or July 2020 (varied by site). This included working directly within their healthcare systems to identify and deploy appropriate virtual and/or telemedicine technologies that worked for their target populations. Two grantees ceased enrollment and follow-up at that time; one due to a need to focus entirely on COVID-19; and another due to the departure of the Site Director, and the refocus of priorities by the new Director/loss of funding for their federally qualified health center. For the two remaining grantees, outreach, enrollment, and delivery of intervention activities that occurred after May or July 2020 took place entirely through virtual modalities. Ultimately, 8 families received a fully virtual intervention (i.e., all home visits were conducted virtually) while 20 families had a visit 3 that was conducted virtually. Sensitivity analyses were conducted to explore the impact this may have had on change in the primary outcome of interest (i.e., asthma control) between home visit 1 and home visit 3 and results were similar regardless of the mode of delivery.

Evaluation Findings

Demographic Characteristics

Between July 2018 and August 2020, 180 families were enrolled by the grantees and received at least one home visit from the CHW as part of their NJ In-home Asthma Intervention Pilot. Completion of evaluation data collection was high with 97% of families with a home visit 1 and 100% of families with a home visit 3 providing evaluation data (**Table 1**). Of the 174 enrolled families with any data, 161 families (93%) had data for both home visit 1 and 3 and were retained in the final evaluation outcome analyses. Among this group, 86 families also completed the evaluation phone follow-up after home visit 3.

Table 1. Home Visits Completed and Evaluation Data Collected, by Timepoint

	Home Visit 1	Home Visit 3	Evaluation Phone follow-up
Families received home visit	180	161	n/a
Families provided evaluation data	174	161	86

As detailed in **Table 2**, most of the 174 enrolled index children were between 4- to 11-years-old (64.4%) and the overall median age was 6 years old (range 2 to 17 years). A majority of children were either Hispanic/Latino (52.9%) or Black/African American (42.5%). The languages spoken most often at home among enrolled families were English (70.2%) and Spanish (410%); few other languages were noted among enrolled families. The enrolled caregivers had a range of educational attainment, the largest proportions had graduated high school (36.0%) or had some college/vocational/technical school experience (34.8%), while nearly one quarter had less than a high school diploma (24.2%). Full data tables for questions asked during Visit 1 and Visit 3 for the 161 enrolled households, are provided in **Appendix A**.

Table 2. Demographic Characteristics of Enrolled Children

	Enrolled Families with <u>Any</u> Evaluation Data (N=174)		Enrolled Families with <u>Complete</u> Evaluation Data (N=161)	
	n	%	N	%
Age at Home Visit 1				
Under 4 years	38	21.8%	35	21.7%
4-11 years	112	64.4%	104	64.6%
12 years and older	24	13.8%	22	13.7%
Median, years (range)	6 (2, 17)		6 (2, 17)	
Race/Ethnicity of Child				
Hispanic or Latino, any race	92	52.9%	86	53.4%
Black or African American, NH	74	42.5%	67	41.6%
White, NH	4	2.3%	4	2.5%
Asian, NH	1	1.0%	1	1.0%
Other, NH	1	1.0%	1	1.0%
Multiple races	2	1.1%	2	1.2%
Sex of Child				
Male	101	58.0%	93	57.8%
Female	73	42.0%	68	42.2%
Caregiver Educational Attainment				

	Enrolled Families with Any Evaluation Data (N=174)		Enrolled Families with Complete Evaluation Data (N=161)	
Did not attend school	1	1.0%	1	1.0%
8th grade or less	21	11.5%	19	11.8%
Some high school but did not graduate	20	11.5%	19	11.8%
High school graduate or GED	66	37.9%	58	36.0%
Some college/vocational or technical school	58	33.3%	56	34.8%
Graduated from college, graduate school	8	4.6%	8	5.0%
Language(s) Spoken at Home				
English	124	71.3%	113	70.2%
Spanish	71	40.8%	66	41.0%
Haitian Creole	1	0.6%	1	0.6%
French	1	0.6%	1	0.6%
Bengali	1	0.6%	1	0.6%
Other	2	1.1%	1	0.6%

Asthma Management at Home

One of the main objectives of the NJ In-home Asthma Pilot was to ensure that caregivers have, understand, and utilize a written Asthma Action Plan for their asthmatic child. At home visit 1, over one quarter (28.6%) of caregivers reported they did not have a written Asthma Action Plan for their index child. Additionally, over a quarter (27.3%) of caregivers reported that they had a written Asthma Action Plan for their child but could not provide it to the CHW for confirmation. At home visit 3, the proportion of caregivers that had a confirmed written asthma action plan had increased significantly from 44.1% at visit 1 to 69.6% at visit 3 (p<0.001) (**Figure 1**).

Figure 1. Presence of Written Asthma Action Plan for Child at Visit 1 and Visit 3 (N=161)

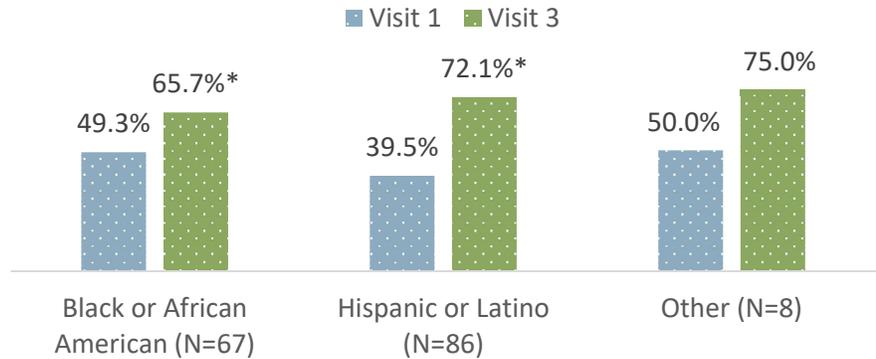


NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 (p<0.05; McNemar’s test)

Additional sub-group analyses were conducted to determine if this outcome differed among particular populations. When examined across race and ethnicity, significant increases between visits 1 and 3 in the proportion of families with a written Asthma Action Plan were seen among Black or African American (from 49.3% to 65.7%; p=0.02) and Hispanic or Latino families (from 39.5% to 72.1%; p<0.001) (**Figure 2**). A positive upward trend was observed among the small group of children of other racial groups; however, significance was likely attenuated due to small sample size (n=8).

Figure 2. Proportion with Written Asthma Action Plan for Child at Visit 1 and Visit 3, by Race/Ethnicity

NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p < 0.05$; McNemar's test)



An increase in the proportion of families reporting having a written Asthma Action Plan were also observed across age groups. Specifically, among index children under 4 years, the proportion of families with a written Asthma Action Plan significantly increased from 40.0% at visit 1 to 68.6% at visit 3 ($p = 0.009$) (Figure 3). A significant increase was also seen among index children aged 4-11 years from 48.1% at visit 1 to 73.1% at visit 3 ($p < 0.001$).

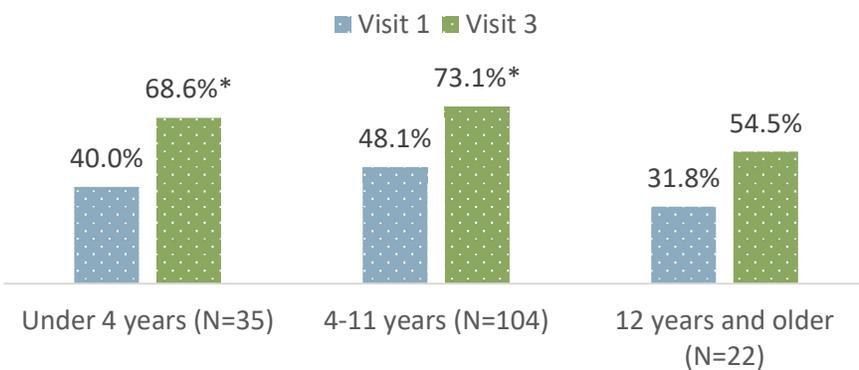
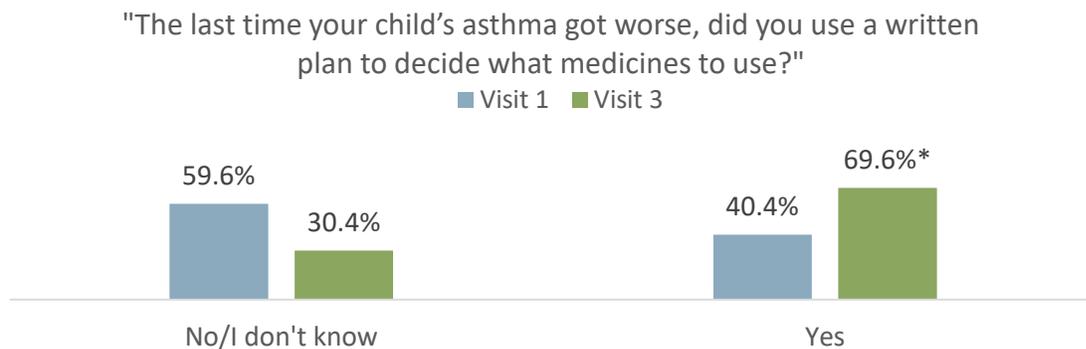


Figure 3. Proportion with Written Asthma Action Plan for Child at Visit 1 and Visit 3, by Age Group

NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p < 0.05$; McNemar's test)

Use of written Asthma Action Plans also increased over the course of the intervention. At visit 1 well under half (40.4%) of caregivers reported that had used an Asthma Action Plan to decide on their index child's medicine the last time their asthma got worse. At home visit 3, this proportion had increased significantly from to 69.6% ($p < 0.001$) (Figure 4).

Figure 4. Use of Written Asthma Action Plan for Index Child at Visit 1 and Visit 3 (N=161)

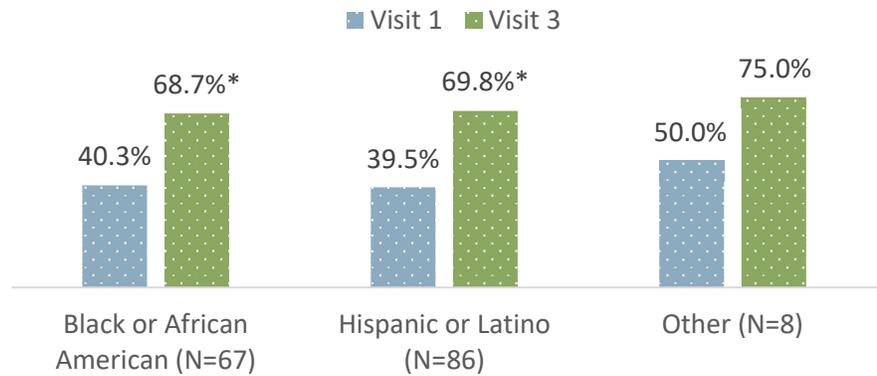


NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p < 0.05$; McNemar's test)

This improvement was also explored by race/ethnicity as shown in **Figure 5**. Among index children identifying as Black or African American, the proportion of caregivers reporting having used a written Asthma Action Plan increased significantly from 40.3% at visit 1 to 68.7% at visit 3 ($p=0.001$). Similarly, a significant increase was seen among those identifying as Hispanic or Latino, with 39.5% at visit 1 to 69.8% at visit 3 ($p<0.001$). A positive upward trend was observed among the small group of children of other racial groups; however, significance was likely attenuated due to small sample size ($n=8$).

Figure 5. Proportion Reporting Use of Written Asthma Action Plan for Index Child at Visit 1 and Visit 3, by Race/Ethnicity

NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p<0.05$; McNemar’s test)



Similarly, when examined by age group, significant improvements in the proportion of caregivers reporting use of a written Asthma Action Plan were observed among index children of all three age groups (**Figure 6**).

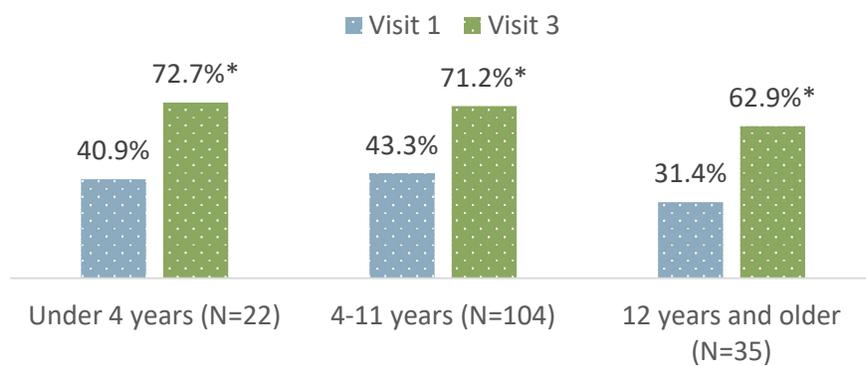
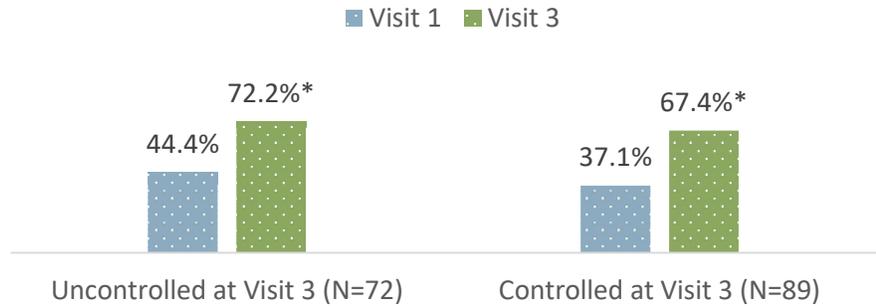


Figure 6. Proportion Reporting Use of Written Asthma Action Plan for Index Child at Visit 1 and Visit 3, by Age Group

NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p<0.05$; McNemar’s test)

Together, these data suggest that after working with the CHW during home visits 1 and 2, the enrolled caregivers were more likely to both have a written action plan in hand and more likely to use that plan with their asthmatic child. However, to assess whether a child’s asthma control (or lack thereof) at visit 3 may have influenced the caregiver’s response to this question, data were further examined by asthma control status at visit 3. As illustrated in **Figure 7**, the proportion of caregivers that indicated using a plan increased significantly for both groups.

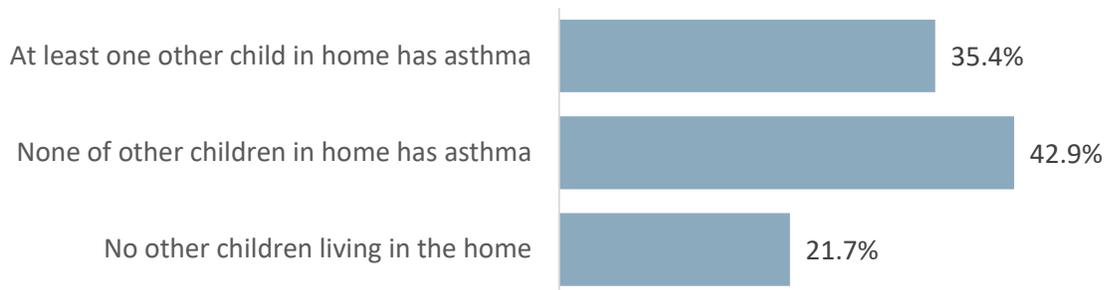
Figure 7. Proportion Reporting Use of Written Asthma Action Plan for Index Child at Visit 1 and Visit 3, by Asthma Control Status at Visit 3



NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p < 0.05$; McNemar's test)

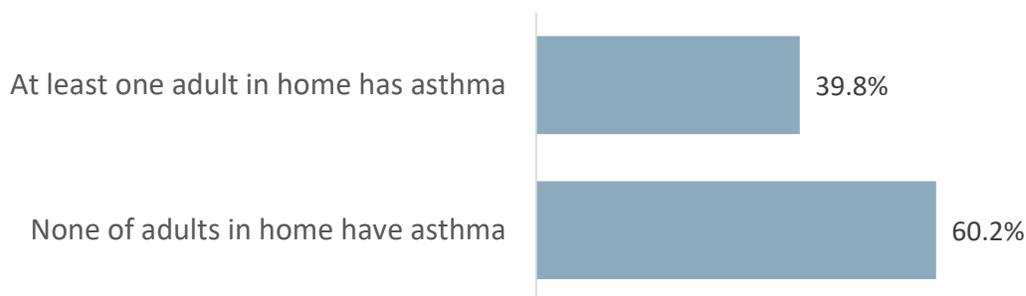
While the focus on the NJ in-home Asthma Pilot was on the enrolled index child, the intervention activities were delivered at the family- or household-level. Thus, caregivers were asked about others living in the home that may also have asthma. As of visit 1, over one third (35.4%) of enrolled households had at least one other child, other than the index child, that was identified as having asthma (*Figure 8*).

Figure 8. Asthma Status of Other Children in the Household (N=161)



Additionally, over one third (39.8%) of enrolled households had at least one adult in the home that was identified as having asthma (*Figure 9*). These findings suggests that the potential benefit of the CHW-led home visits was likely to extend beyond just the index child for many households.

Figure 9. Asthma Status of Adults in the Household(N=161)



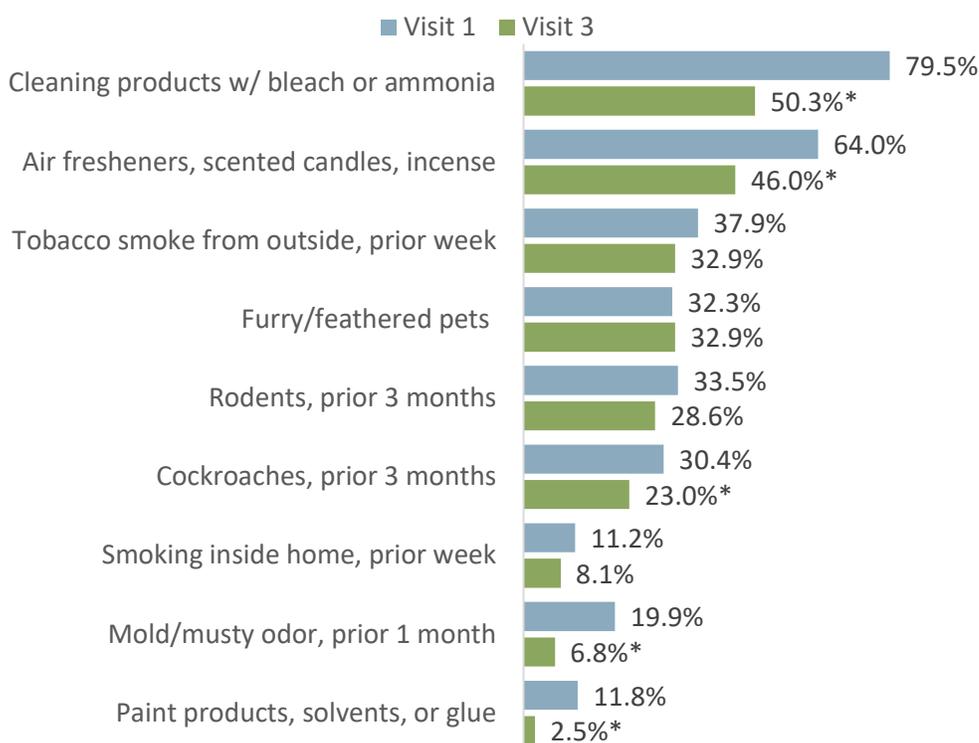
Environmental Assessment

Another main objective of the NJ in-home Asthma Pilot was to educate caregivers about asthma triggers that may be present in the home so that they could be mitigated or reduced. The environmental assessment, conducted by the CHW in the home, identified a wide range of indoor asthma triggers that could be influencing the index child's asthma control.

Results of the caregiver-reported section of the environmental assessment indicated many homes had significant asthma triggers present at visit 1 (**Figure 10**). The majority of enrolled caregivers reported the use of cleaning products that contain bleach or ammonia (79.5%) or air fresheners, scented candles, or incense (64.0%) in the home. Over a quarter of caregivers reported they had a rodent issue (33.5%) or a cockroach issue (30.4%) in the prior 3 months. It is unclear, however, whether these may be under-estimates as self-report of stigmatized conditions are vulnerable to under-reporting. However, smoking inside the home was reported by only a small proportion of caregivers (11.2%), though over a third (37.9%) did report tobacco smoke coming from outside the home in the prior week.

In general, a smaller proportion of the caregivers reported the presence of these various triggers in the home at visit 3 compared to visit 1. Particularly large, and statistically significant, reductions were observed for cleaning products w/bleach or ammonia - from 79.5% at visit 1 to 50.3% at visit 3 ($p < 0.001$) and for air fresheners, scented candles, incense – from 64.0% at visit 1 to 46.0% at visit 3 ($p < 0.001$).

Figure 10. Caregiver Reported Asthma Triggers in the Home at Visit 1 and Visit 3 (N=161)



NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p < 0.05$; McNemar's test)

The two most frequent asthma triggers reported by caregivers were also explored by race/ethnicity and age group. The reduction in the presence of cleaning products w/bleach or ammonia in the home was observed across all race/ethnicity groups with statistically significant declines among those identifying as Black or African American or Hispanic or Latino (**Figure 11**).

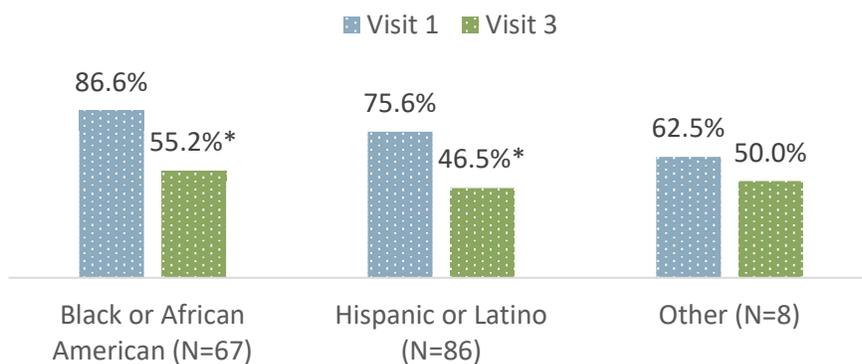


Figure 11. Caregiver Reported Presence of Cleaning Products in the Home at Visit 1 and Visit 3, by Race/Ethnicity

NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p < 0.05$; McNemar's test)

The reduction in the presence of cleaning products w/bleach or ammonia in the home was also observed across all age groups of index children with statistically significant declines among those under 4 years of age or between 4 and 11 years of age (**Figure 12**).

Figure 12. Caregiver Reported Presence of Cleaning Products in the Home at Visit 1 and Visit 3, by Age Group



NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p < 0.05$; McNemar's test)

The reduction in the presence of air fresheners in the home was observed primarily among those identifying as Black or African American, among whom the proportion declined from 74.6% at visit 1 to 47.8% at visit 3 ($P < 0.05$). A smaller and non-significant reduction was observed among those identifying as Hispanic or Latino (**Figure 13**).

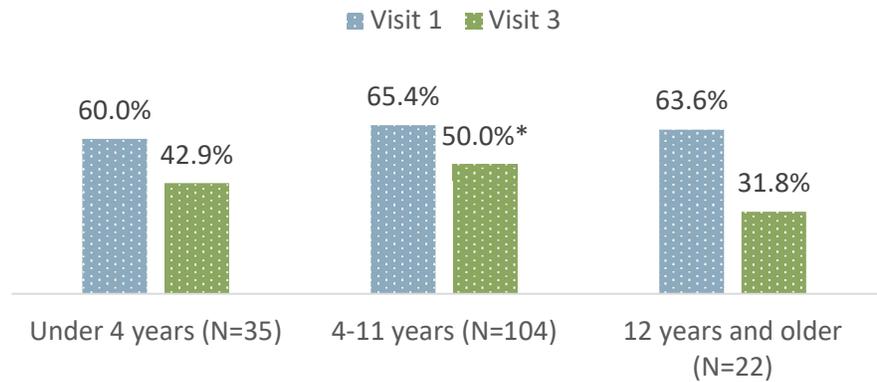


Figure 13. Caregiver Reported Presence of Air Fresheners in the Home at Visit 1 and Visit 3, by Race/Ethnicity

NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p < 0.05$; McNemar's test)

The reduction in the presence of air fresheners in the home was observed across all age groups, though statistical significance was attenuated in all but the largest group of index children between 4 to 11 years of age (**Figure 14**).

Figure 14. Caregiver Reported Presence of Air Fresheners in the Home at Visit 1 and Visit 3, by Age Group



NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p < 0.05$; McNemar's test)

The CHW observation section of the environmental assessment involved a series of individual room checklists. These checklists identify the presence of specific asthma triggers throughout the home, such as dust, mold or mildew, water damage, evidence of pests, odors, etc. The room observation findings were combined with the caregiver reported triggers to generate a single composite environmental score that incorporates the presence of the key asthma triggers - dust, mold, pest, smoke, pet, and chemical.

The total environmental composite score ranged from 0 (indicating none of the six triggers were present in the child's home) to 6 (indicating all six of the triggers were present in the child's home). Analyses of the data for home visit 1 yielded an average environmental composite score of 3.2 which suggested a proportion of homes had a number of potential asthma triggers present at visit 1. By home visit 3, the average composite score had declined significantly to 2.5 ($P < 0.001$) (Figure 15). Overall, 49.1% of families had a decrease of at least one full point in their total environmental composite score. These findings suggest that after working with the CHW over home visits 1 and 2, some mitigation of the identified asthma triggers in the home had taken place.

Figure 15. Average Asthma Environment Trigger Composite Score at Visit 1 and Visit 3 (N=161)



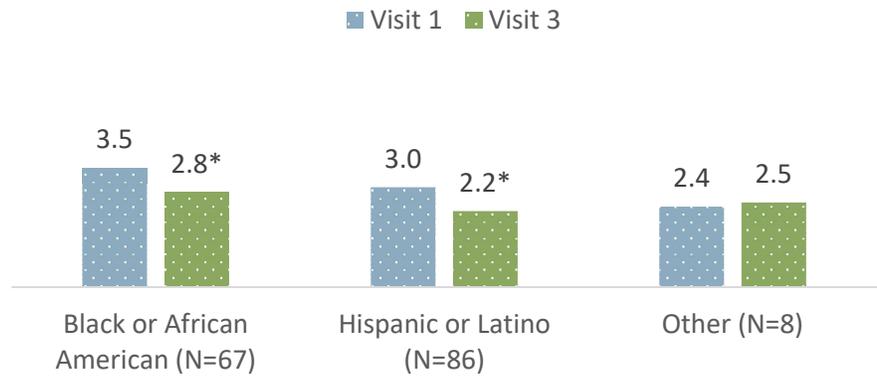
The composite score incorporates the presence of the following asthma triggers - dust, mold, pest, smoke, pet, and chemical - based on caregiver reports and CHW observations. The composite score ranges from 0 to 6 (indicating all six of the triggers were present in the child's home).

NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p < 0.05$; McNemar's test)

Significant reductions in average composite scores were observed among families with index children identifying as Black or African as well as among those identifying as Hispanic or Latino (Figure 16). However, no change was observed among the small group of children of other racial groups ($n=8$).

Figure 16. Average Asthma Environment Trigger Composite Score at Visit 1 and Visit 3, by Race/Ethnicity

NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p < 0.05$; McNemar's test)



By age group, significant reductions in average composite score were observed among families with index children under 4 years and between 4 to 11 years of age (**Figure 17**). Among families with index children aged 12 and older, the average composite score declined, however the change was not statistically significant. Of note, the average environmental trigger composite scores appeared to increase with the age of the index child.



Figure 17. Average Asthma Environment Trigger Composite Score at Visit 1 and Visit 3, by Age Group

NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p < 0.05$; McNemar's test)

Asthma Control Scale

Ultimately, the key outcome of interest for the NJ In-home Asthma Pilot was improved asthma control among index children. To assess this outcome, the CHWs administered a validated asthma control scale that was appropriate for the child's age. For younger children, the caregiver answered the asthma control scale questions while for older children, the index child answered some of the questions themselves. Consistent with the ages of the enrolled index children, the majority of index children were screened using the Childhood ACT which is specific to children between the ages of 4 and 11 years (**Table 2**).

Table 2. Asthma Control Scale used by CHW (N=161)

	TRACK Under 4 Years	Childhood ACT 4 to 11 Years	ACT 12 years and older
Home Visit 1	n=38	n=101	n=22
Home Visit 3	n=36	n=103	N=22

NOTE: The TRACK scale was administered to two participants at visit 1, but the Childhood ACT scale at visit 3, both aged 4 years.

Regardless of which asthma control scale was used, scores were categorized based upon level of asthma control (i.e., uncontrolled vs. controlled), this allowed for the results of the asthma screenings to be aggregated across the age groups.

Nearly three-quarters (73.3%) of enrolled index children were experiencing uncontrolled asthma at visit 1. After working with the CHW over home visit 1 and home visit 3, the proportion of index children with controlled asthma increased significantly from 26.7% at visit 1 to 44.7% at visit 3 ($P < 0.001$) (**Figure 18**).

Figure 18. Asthma Control at Visit 1 and Visit 3 (N=161)



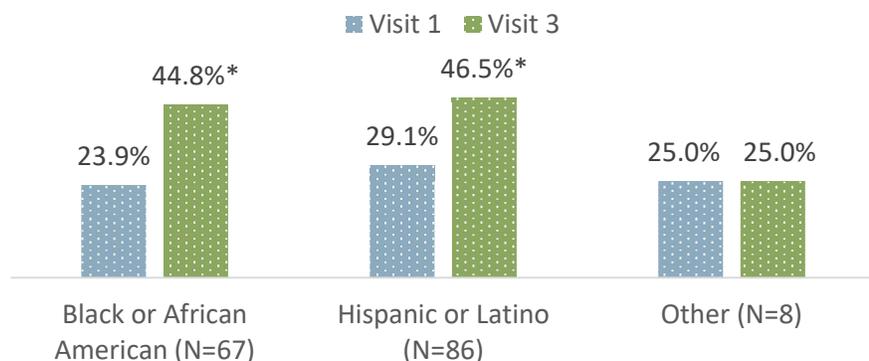
Asthma Control Scales: TRACK for under 4; ACT 4-11 for age 4 to 11; ACT 12+ for age 12 and older

NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p < 0.05$; McNemar's test)

A number of sub-group analyses were conducted to determine if the observed change in asthma control differed for any particular population. When examined by race/ethnicity, the significant increase in asthma control was similarly observed among those who identified as Black or African American ($p = 0.004$) and who identified as Hispanic or Latino ($p = 0.004$) (**Figure 19**). Index children of other races did not appear to experience an increase in controlled asthma, however the sample size in the current data set is small ($N = 8$). This data further illustrates that Black or African American children had slightly lower rate of asthma control at home visit 1 (23.9%) compared to the other groups.

Figure 19. Proportion with Controlled Asthma at Visit 1 and Visit 3, by Race/Ethnicity

NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p < 0.05$; McNemar's test)



When examined by age, the improvements in asthma control between Visit 1 and Visit 3 were observed for index children of each age group, although the improvement was most robust and statistically significant for those aged 4-11 years ($p < 0.001$) (**Figure 20**). Among index children who were under 4 years of age, the improvement was small and non-significant compared to older children. However, children under 4 years had notably low rate of asthma control at home visit 1 (14.3%) which may indicate this group has additional challenges or barriers to gaining asthma control.

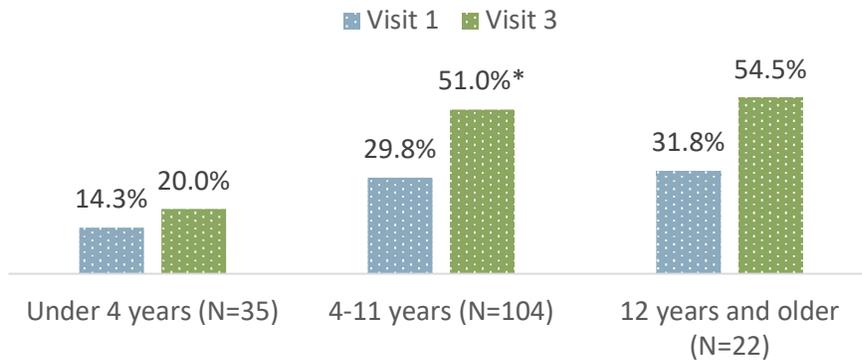
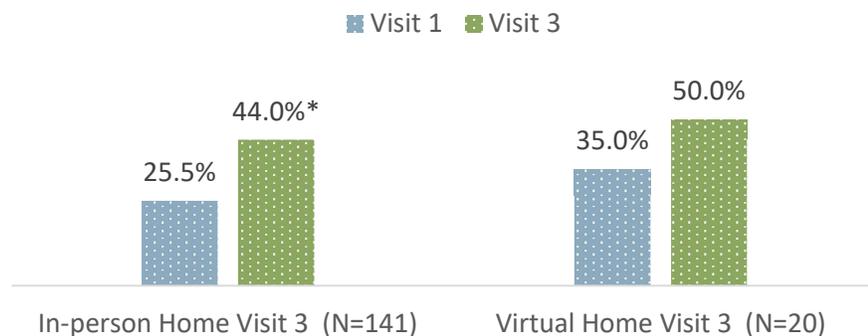


Figure 20. Proportion with Controlled Asthma at Visit 1 and Visit 3, by Age Group

NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p < 0.05$; McNemar's test)

As described previously, the COVID-19 pandemic began in March 2020 and state and local emergency orders, mandates, and closures dramatically impacted the mode of intervention delivery for the CHW-led home visits for the final eight months of the intervention period. Between March and April 2020, grantees worked together and within their respective organizations to develop and launch virtual models of program delivery. A total of 8 families received a fully virtual intervention (i.e., all home visits were conducted virtually) while 20 families had a visit 3 that was conducted virtually. To explore the potential impact of this change in program delivery mode, asthma control was compared over time stratified by the mode of home visit 3 (**Figure 21**). Improvement in the proportion of children with controlled asthma was observed in both groups, although statistical significance was not reached in the smaller, virtual group.

Figure 21. Proportion with Controlled Asthma at Visit 1 and Visit 3, by Mode of Visit 3 Delivery

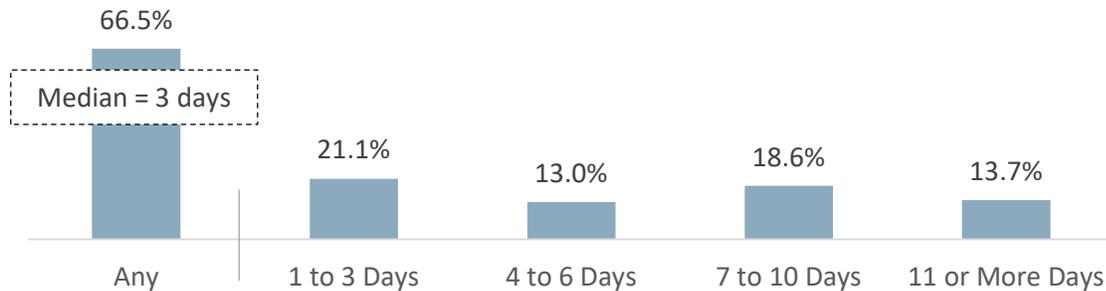


NOTE: Asterisk (*) denotes statistical significance between visit 1 and visit 3 ($p < 0.05$; McNemar's test)

Days Missed Due to Asthma Symptoms

One consequence of uncontrolled asthma is an increased number of missed work or school days for caregivers and missed childcare or school days for the child. To assess changes in this outcome, caregivers were asked to report the number of missed days in the 6 months prior to the visit. At visit 1, the majority (66.5%) of enrolled caregivers reported having missed at least 1 day of work/school due to their child's asthma in the past 6 months and the overall median was 3 missed days (**Figure 22**). However, the range of missed days for caregivers was notably wide. While the largest proportion of caregivers reported between 1 and 3 days missed (21.1%), over 10% of caregivers reported missed days in each of the categories of 4 to 6 days (13.0%), 7 to 10 days (18.6%), and 11 or more days (13.7%).

Figure 22. Number of Work/School Days Caregiver Missed Due to Child’s Asthma in Prior 6 Months at Visit 1 (N=161)



When stratified by race/ethnicity, missed days were more prevalent at home visit 1 among caregivers to Black or African American children compared to Hispanic or Latino children (**Figure 23**) - the proportion of any missed days was 74.6% vs. 59.3%, although not statistically significant ($p=0.06$) and the median number of days was significantly higher (4 days vs. 2 days; $p=0.005$). While days missed was notably higher among caregivers to children of other race groups, the small call count precluded significance testing.

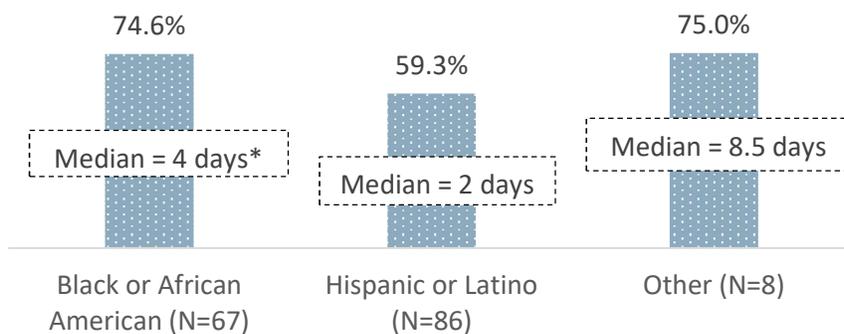
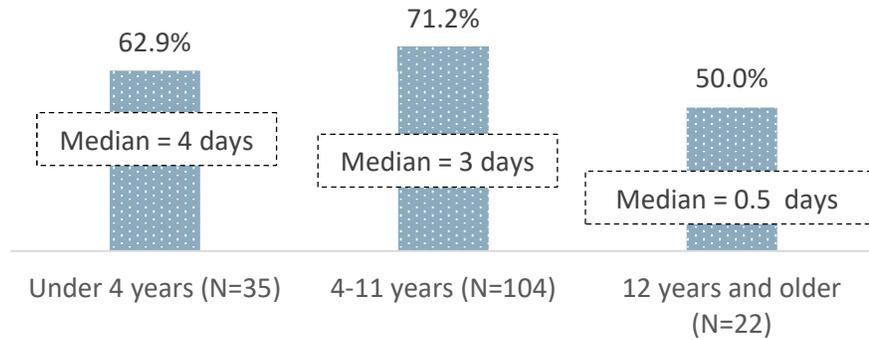


Figure 23. Any Work/School Days Caregiver Missed Due to Child’s Asthma in Prior 6 Months at Visit 1, by Race/Ethnicity

NOTE: Asterisk (*) denotes statistical significance between Black or African American and Hispanic or Latino median days ($p<0.05$; Wilcoxon rank-sum)

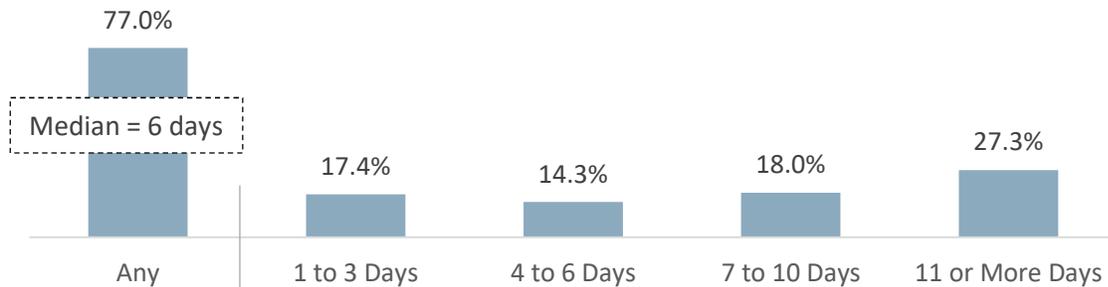
When stratified by age group, the prevalence of any missed days at home visit 1 was similar among caregivers to children under 4 years (62.9%), 4 to 11 years (71.2%), and age 12 and over (50%) (**Figure 24**) – however the median number of days missed was 4 days and 3 days for the two younger groups compared to the older group (0.5 days), although not a significant difference ($p=0.37$). This finding may reflect a smaller impact of child’s asthma on caregiver’s ability to work or attend school when a child is older and more able to remain home alone.

Figure 24. Any Work/School Days Caregiver Missed Due to Child's Asthma in Prior 6 Months at Visit 1, by Age Group



Among all index children, 3 out of 4 (77.0%) were reported to have missed at least 1 childcare or school days due to their asthma in the prior 6 months (**Figure 25**). The range in number of missed days was wide and skewed towards the higher categories; over one quarter (27.3%) were reported to have missed 11 or more days and the overall median number of days missed was 6.

Figure 25. Number of Childcare/School Days Index Child Missed Due to Asthma in prior 6 months at Visit 1 (N=161)



When stratified by race/ethnicity, missed days were greater at home visit 1 among children who were Black or African American compared to Hispanic or Latino children (**Figure 26**) - the proportion of any missed days was similar in the two groups (88.7% and 79.2%, respectively), however the median number of days missed was significantly higher for Black or African American children (8 days vs. 4 days; $p < 0.001$). While days missed were particularly high among children of other race groups (median 13 days), though the small call count precluded significance testing.

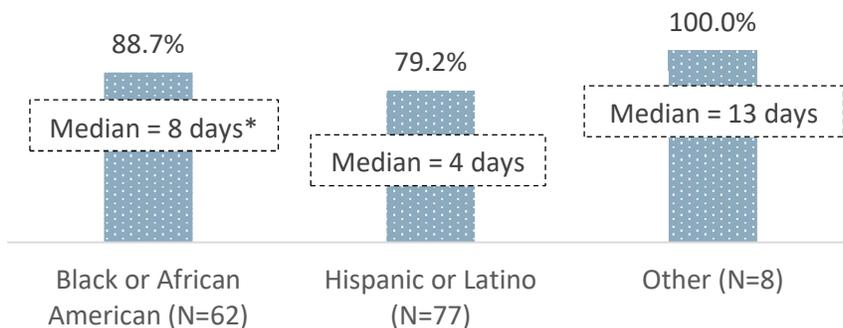
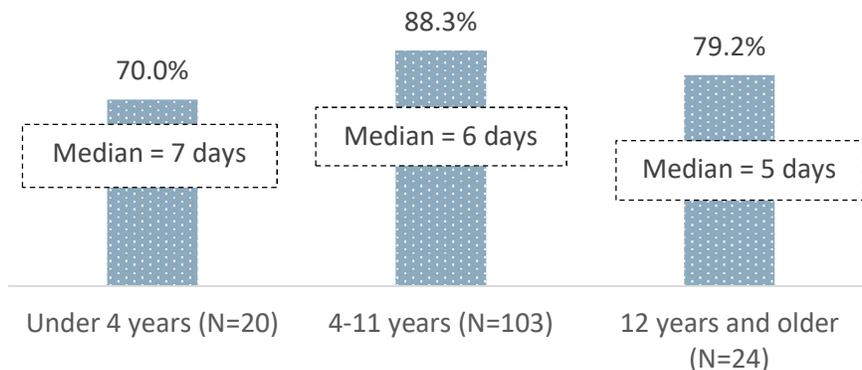


Figure 26. Any Childcare/School Days Index Child Missed Due to Asthma in prior 6 months at Visit 1, by Race/Ethnicity

NOTE: Asterisk (*) denotes statistical significance between Black or African American and Hispanic or Latino median days ($p < 0.05$; Wilcoxon rank-sum)

Missed childcare/school days was fairly consistent across groups when stratified by the age of index children, although any missed days was slightly higher among children aged 4 to 11 (88.3%) or 12 years and older (79.2%), the median number of days missed was slightly higher among those under 4 years (median of 7 days), although no statistically significant differences were observed (**Figure 27**).

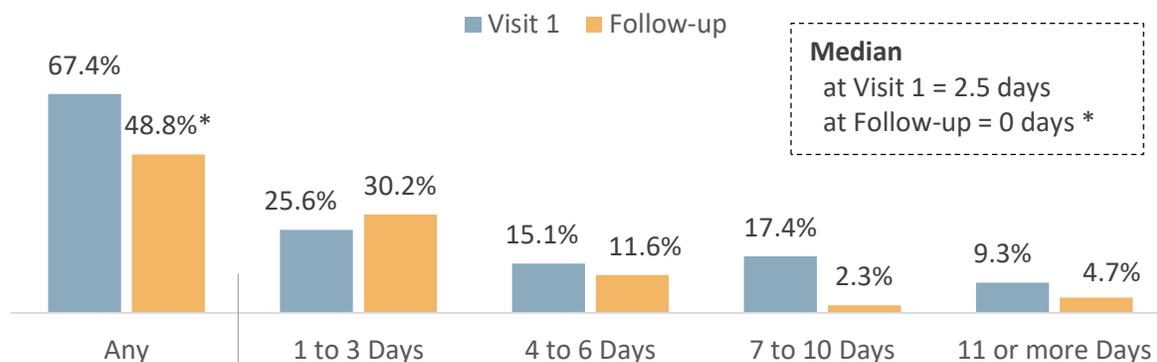
Figure 27. Any Childcare/School Days Index Child Missed Due to Asthma in prior 6 months at Visit 1, by Age Group



The prevalence and extent of missed days (for caregivers or index children) were based on a 6-month lookback period. In order to avoid comparisons of overlapping time periods between visit 1 and visit 3 for these questions, analyses of change in missed days was necessarily limited to caregivers who had elected to complete the evaluation phone follow-up (n=86). Full data tables for questions asked during the Visit 1, Visit 3, and Evaluation Follow-up for these 86 households, are provided in **Appendix B**.

Within this sub-group, the missed days in the prior 6 months appeared to decline for both caregivers and index children. The proportion of caregivers that reported any missed days declined slightly from 67.4% at visit 1 to 48.8% at evaluation follow-up and the median number of days missed by the caregiver declined significantly from 2.5 days to 0 days (p=0.001) (**Figure 28**).

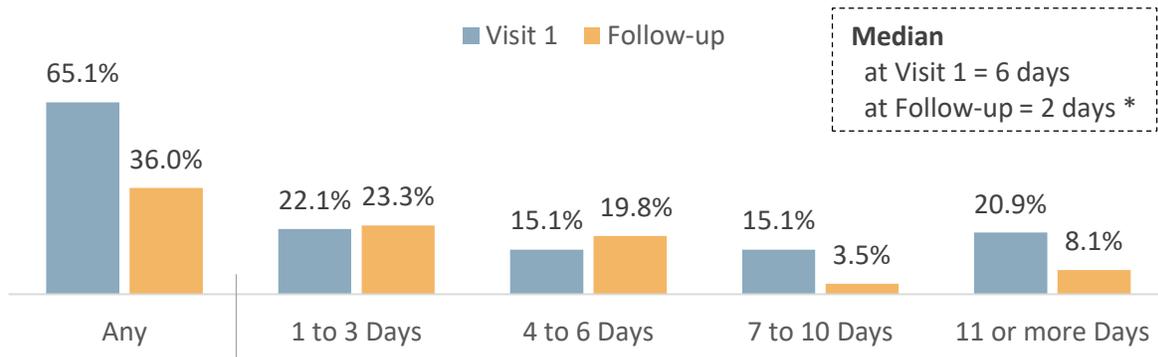
Figure 28. Number of Work/School Days Caregiver Missed due to Child's Asthma in Prior 6 Months at Visit 1 and Evaluation Follow-up (N=86)



NOTE: Asterisk (*) denotes statistical significance between visit 1 and evaluation follow-up (p<0.05; McNemar's test or Wilcoxon signed-rank test)

Similarly, among index children the proportion reported to have missed any days declined from 65.1% at visit 1 to 36.0% at evaluation follow-up and the median number of days missed by the index child declined significantly from 6 days to 2 days (p<0.001) (**Figure 29**).

Figure 29. Number of Childcare/School Days Index Child Missed Due to Asthma in Prior 6 Months at Visit 1 and Follow-up (N=74)

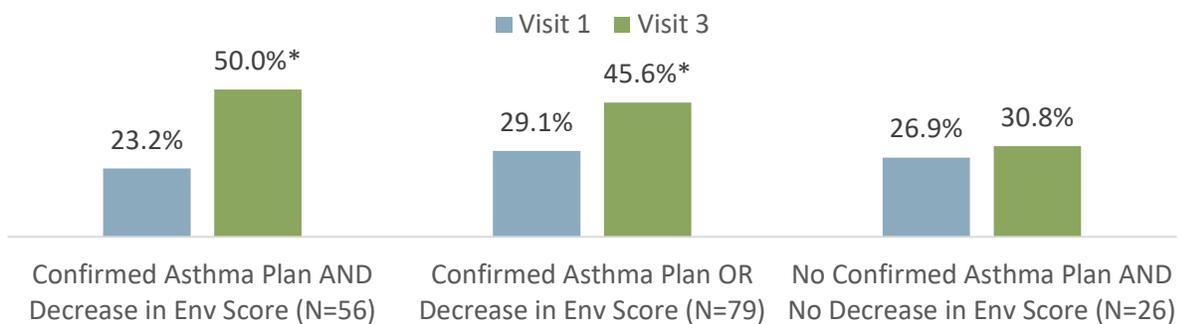


NOTE: Asterisk (*) denotes statistical significance between visit 1 and evaluation follow-up ($p < 0.05$; Wilcoxon signed-rank test); Figure does not include children where childcare or school was not applicable at visit 1 (N=12)

Impact of Intervention Activities

The overarching evaluation did not specifically track the individual educational topics covered or the material resources provided to caregiver(s) during the CHW-led home visits. However, analyses were conducted to determine how adoption of the primary strategies involved in the intervention model (i.e., having/using an asthma action plan and identifying/mitigating asthma triggers in the home), may be associated with change in asthma control between visit 1 and visit 3. **Figure 30** illustrates the proportion of enrolled children with controlled asthma, stratified according to these two indicators of behavioral change. Results showed most robust and statistically significant improvements among families that had BOTH a confirmed asthma action plan and a decrease in their environmental score (n=56) while little change in control was observed among families who had NEITHER a confirmed asthma action plan nor a decrease in their environmental score at visit 3 (n=26).

Figure 30. Controlled Asthma at Visit 1 and Visit 3, by Indicators of Behavioral Change at Visit 3



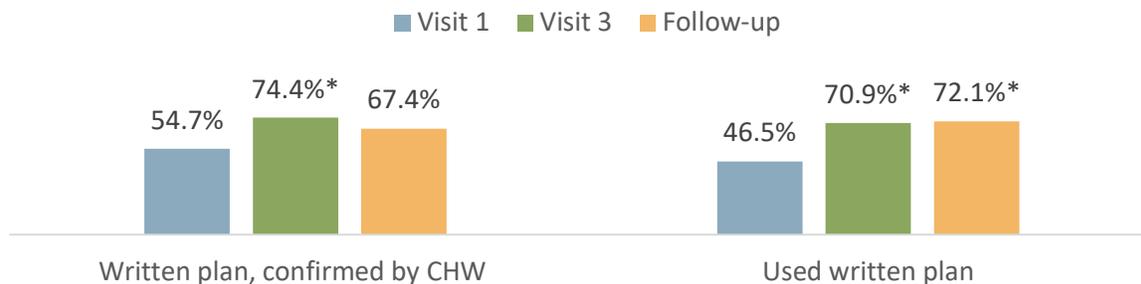
NOTE: Asterisk (*) denotes statistical significance compared to visit 1 ($p < 0.05$; McNemar's test)

Exploration of Evaluation Follow-up data

Evaluation follow-up data were collected for nearly half (86 of 174) of families with complete visit 1 and visit 3 evaluation data. The average time between home visit 3 and the evaluation follow-up was 6.5 months, ranging from 2.3 months to 18.6 months. The additional datapoint provides an opportunity to explore whether and/or how the improvements in asthma control were sustained past home visit 3.

Results were promising and indicated that the impact achieved while working with CHWs was sustained beyond the home visit time period. As illustrated in **(Figure 31)** among families with evaluation follow-up data, the significant increase in the proportion of caregivers who had a confirmed written asthma action plan (from 54.7% at visit 1 to 74.4% at visit 3) remained high (67.4%) at the follow-up timepoint. Similarly, the significant increase in the proportion of caregivers who had used an asthma action plan to decide on medicines for their child (from 46.5% at visit 1 to 70.9% at visit 3) also remained high (72.1%) at the follow-up timepoint.

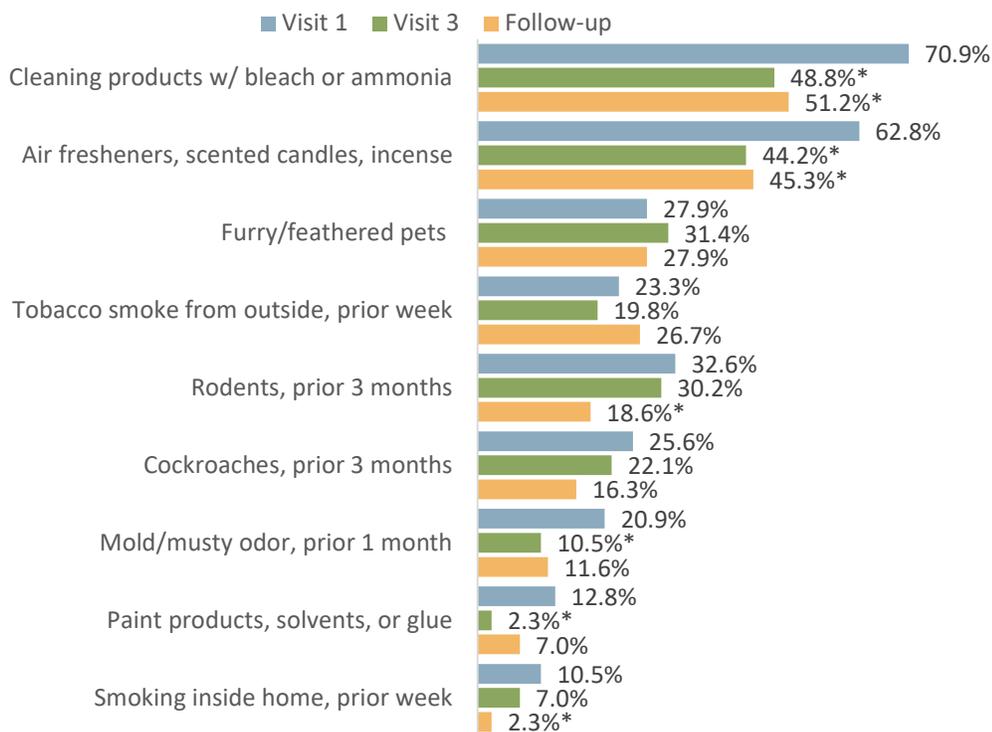
Figure 31. Proportion of Caregivers Reporting Having Written Asthma Action Plan and Using Written Action Plan for Index Child at Visit 1 and Visit 3 and Follow-up (N=86)



NOTE: Asterisk (*) denotes statistical significance compared to visit 1 ($p < 0.05$; McNemar's test)

While in-home observations by CHWs were not conducted during the evaluation follow-up (conducted via phone), caregivers were still asked about the caregiver questions about the presence of specific asthma triggers in the home. **(Figure 32)**.

Figure 32. Caregiver Reported Asthma Triggers in the Home at Visit 1 and Visit 3 and Follow-up (N=86)



NOTE: Asterisk (*) denotes statistical significance compared to visit 1 ($p < 0.05$; McNemar's test)

Among families with evaluation follow-up data, the significant reductions in the presence of cleaning products with bleach or ammonia and use of air fresheners, scented candles, or incense that were achieved between home visit 1 and home visit 3 were sustained at the evaluation follow-up timepoint.

Furthermore, the significant improvement in asthma control observed among index children between visit 1 and visit 3 was also sustained at the evaluation follow-up timepoint (**Figure 33**). Among those with evaluation follow-up data, the proportion of index children with controlled asthma increased significantly from 31.4% at visit 1 to 46.5% at visit 3. Between visit 3 and the follow-up timepoint, the proportion of index children with controlled asthma was increased slightly from 46.5% to 58.1%, however the rates were not significantly different between those two timepoints.

Figure 33. Asthma Control at Visit 1, Visit 3, and Follow-up (N=86)



Asthma Control Scales: TRACK for under 4; ACT 4-11 for age 4 to 11; ACT 12+ for age 12 and older

NOTE: Asterisk (*) denotes statistical significance compared to visit 1 ($p < 0.05$; McNemar's test)

When these analyses were further stratified by race/ethnicity, results were similar for both Black or African American children (asthma control increased from 30.0% at visit 1 to 55.0% at evaluation follow-up, $P < 0.05$) and for Hispanic or Latino children (asthma control increased from 32.6% at visit 1 to 62.8% at evaluation follow-up, $P < 0.05$) (**Figure 34**).

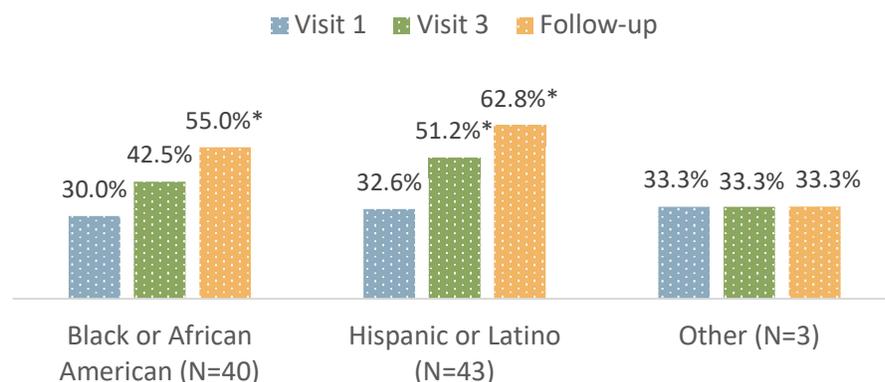
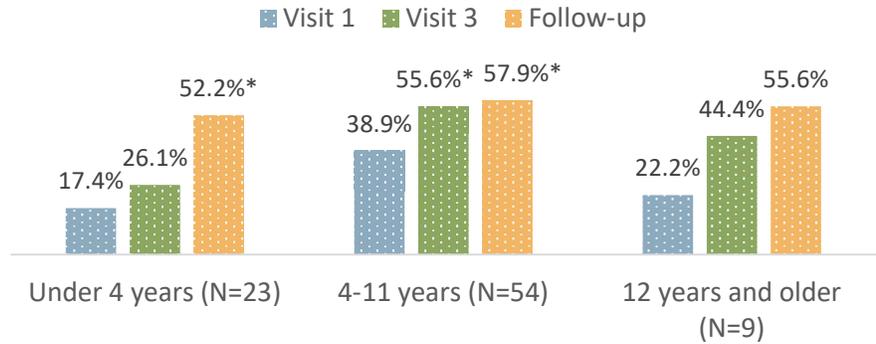


Figure 34. Proportion with Controlled Asthma at Visit 1, Visit 3, and Follow-up, by Race/Ethnicity

NOTE: Asterisk (*) denotes statistical significance compared to visit 1 ($p < 0.05$; McNemar's test)

While analyses of asthma control among children under age 4 was not observed to increase significantly between home visit 1 and home visit 3, among those with evaluation follow-up date, significantly improvement was observed, to a level of controlled asthma similar to older age groups. (**Figure 35**) Specifically, controlled asthma increased from 17.4% at visit 1 to 52.2% at evaluation follow-up for children under 4 years ($P < 0.05$). Among children in the older age groups, the improvements in asthma control that had been achieved between visit 1 and visit 3 appear to have been sustained by the evaluation follow-up timepoint. However, statistical significance was attenuated among children in the 12 years and older group due to small sample size ($n = 9$).

Figure 35. Proportion with Controlled Asthma at Visit 1 and Visit 3 and Follow-up, by Age Group



NOTE: Asterisk (*) denotes statistical significance compared to visit 1 ($p < 0.05$; McNemar's test)

It is important to note that some characteristics differed between the families with complete evaluation follow-up data and those lost to follow-up. Specifically, the median age of index children with follow-up data was significantly younger (5 years vs. 7 years; $P < 0.001$) (**Table 4**). This loss to follow-up among older children, may account for the attenuated significance related to asthma control in this group.

Table 4. Demographic Characteristics of Enrolled Children by Follow-up Status

	Enrolled Families with <u>Incomplete</u> Evaluation Follow-up Data (N=88)		Enrolled Families with <u>Complete</u> Evaluation Follow-up Data (N=86)		p
	n	%	N	%	
Age at Home Visit 1					0.19
Under 4 years	15	17.0%	23	26.7%	
4-11 years	58	65.9%	54	62.8%	
12 years and older	15	17.0%	9	10.5%	
Median, years (range)*	7 (2, 17)		5 (2, 17)		<0.001
Race/Ethnicity of Child					0.51
Hispanic or Latino	49	55.7%	43	50.0%	
Black or African American	34	38.6%	40	46.5%	
Other	5	5.7%	3	3.5%	
Sex of Child					0.54
Male	49	55.7%	52	60.5%	
Female	39	44.3%	34	39.5%	
Caregiver Educational Attainment					0.06
Did not attend school	1	1.1%	0	0.0%	
8th grade or less	13	14.8%	8	9.3%	
Some high school but did not graduate	14	15.9%	6	7.0%	
High school graduate or GED	33	37.5%	33	38.4%	
Some college/vocational or technical school	26	29.5%	32	37.2%	
Graduated from college, graduate school	1	1.1%	7	8.1%	
Language(s) Spoken at Home					
English	60	68.2%	64	74.4%	0.40
Spanish	37	42.0%	34	39.5%	0.76
Other	2	2.2%	3	3.6%	

NOTE: Asterisk (*) denotes statistical significance between families with incomplete evaluation follow-up data and those with complete evaluation follow-up data ($p < 0.05$); Chi-square tests were used for age group, race/ethnicity of child, and caregiver educational attainment; Wilcoxon rank-sum test was used for median age in years; and Fisher's exact tests were used for sex of child, English, and Spanish languages

Discussion

Evaluation data suggest that caregivers enrolled in the NJ in-Home Asthma Education Pilot were able to successfully adopt the key asthma management skills and behaviors that the intervention had targeted. This included having and using a written Asthma Action Plan for their index child and reducing the number of environmental asthma triggers in the home. Furthermore, families experienced significantly improved asthma control among index children and there was evidence suggesting reductions in missed work/school/childcare days were also achieved between home visit 1 and follow-up. Together, these findings suggest that the CHW-led intervention was ultimately successful in improving the health and wellbeing of children with poorly controlled asthma, as well as environmental conditions in the home.

Importantly, this pilot was conducted entirely with families served by Medicaid and who primarily identified as Hispanic/Latino and Black/African American – populations known to be disproportionately burdened by asthma and who encounter greater barriers to achieving asthma control. The positive and significant findings of this evaluation suggest the intervention components and educational content were designed to be relevant and valuable to the target population and may be a useful approach to mitigating asthma-related racial and ethnic health disparities among children.

It is also essential to recognize the value of CHW's in delivering the intervention model. CHWs are frequently members of the community in which enrolled families lived, often language and/or cultural concordant with the families they work with, and always attuned to the full context of a family's needs. By working with the CHW over a series of home visits, caregivers and families had the opportunity to gain knowledge, practice skills, seek further support, and see improvement in their child in their own time and based on their unique family/living situation. Additionally, CHWs are able to gain insight into the participants' homes – providing valuable information to other clinicians who serve them (e.g., does the child have a cat who sleeps on their bed). This helps clinicians to better treat their patients, and to operate at the top of their license.

While asthma control was not measured for others in the household, well over a third of caregivers did report there was at least one other household member in addition to the index child with asthma. It is plausible that other children and adults in the household may have also benefited from the intervention and the improved environmental conditions in the home. Furthermore, learning self-management skills related to one chronic disease may help families and patients to practice self-management skills for other chronic diseases across a lifetime. All of this would suggest that CHW-led asthma home interventions could greatly contribute to the health of families more broadly than the targeted child with asthma.

The COVID pandemic must be noted in relation to the delivery of this intervention. It's impact during the final months of program delivery proved to be an enormous challenge for grantees. However, the experience of the two provider sites that adapted and continued program delivery offered an opportunity to explore the potential of this intervention to be translated into an entirely virtual mode of delivery. However, data from during the COVID-19 pandemic suggest that ED utilization dramatically declined for pediatric asthma, among other conditions, in parts of the US, including at the grantee sites. It remains unclear if this was due to fear of seeking care during or pandemic or impacts of closures/distancing/masks on asthma exacerbation. However, what is known is that it impacted recruitment and enrollment in the last several months of the intervention.

Ongoing evaluation work for the pilot based on the index child's Medicaid data is currently underway to determine what the impact of the pilot may have had on healthcare utilization or costs. However, the findings of the in-home evaluation offer great potential for a broader population impact if the program can be sustained and replicated to reach more Medicaid families at more provider sites.

APPENDIX A.

Caregiver Questionnaire – Asthma Action Plan

Table 32. Participants Provided with Written Action Plan by Doctor or Other Health Professional, as Confirmed by CHW, by Timepoint

	Aggregate Visit 1 (N=161)		Aggregate Visit 3 (N=161)	
	n	%	n	%
No written plan	46	28.6%	23	14.3%
Written plan, and confirmed by CHW	71	44.1%	112	69.6%
Written plan, but not confirmed by CHW	44	27.3%	26	16.1%

Table 33. Reported Use of Written Action Plan to Decide on Medications, by Timepoint

	Aggregate Visit 1 (N=161)		Aggregate Visit 3 (N=161)	
	n	%	n	%
Yes	65	40.4%	112	69.6%
No	93	57.8%	48	29.8%
I don't know	3	1.9%	1	0.6%

Table 34. Reported Number of Work/School Days Caregiver(s) Missed Due to Child's Asthma in Past 6 Months, by Timepoint

	Aggregate Visit 1 (N=161)		Aggregate Visit 3 (N=161)	
	n	%	n	%
None	54	33.5%	75	46.6%
1 to 3	34	21.1%	40	24.8%
4 to 6	21	13.0%	18	11.2%
7 to 10	30	18.6%	17	10.6%
11 or more	22	13.7%	11	6.8%
Median	3		1	

Table 35. Reported Number of Childcare/School Days Child Missed Due to Asthma in Past 6 Months, by Timepoint

	Aggregate Visit 1 (N=161)		Aggregate Visit 3 (N=161)	
	n	%	n	%
None	23	14.3%	46	28.6%
1 to 3	28	17.4%	34	21.1%
4 to 6	23	14.3%	33	20.5%
7 to 10	29	18.0%	19	11.8%
11 or more	44	27.3%	23	14.3%
Not applicable	14	8.7%	6	3.7%
Median	6		3	

Table 36. Reported Child Receiving Flu Shot in Past 12 Months, by Timepoint

	Aggregate Visit 1 (N=161)		Aggregate Visit 3 (N=161)	
	n	%	n	%
Yes	108	67.1%	108	67.1%
No	50	31.1%	50	31.1%
I don't know	3	1.9%	3	1.9%

Asthma Control Scales

Table 37. Of Children Under Age 4, Child's TRACK Scale Results, by Timepoint

	Aggregate Visit 1 (N=38)		Aggregate Visit 3 (N=36)	
	n	%	n	%
Uncontrolled (< 80)	33	86.8%	29	80.6%
Controlled (≥ 80)	5	13.2%	7	19.4%

*Note: difference in sample size due to use of different Asthma scale between timepoints

Table 38. Of Children Ages 4 to 11, Child's ACT 4-11 Scale Results, by Timepoint

	Aggregate Visit 1 (N=101)		Aggregate Visit 3 (N=103)	
	n	%	n	%
Uncontrolled (≤ 19)	70	69.3%	50	48.5%
Controlled (> 19)	31	30.7%	53	51.5%

*Note: difference in sample size due to use of different Asthma scale between timepoints

Table 39. Of Children Ages 12 and Older, Child's ACT 12+ Scale Results, by Timepoint

	Aggregate Visit 1 (N=22)		Aggregate Visit 3 (N=22)	
	n	%	n	%
Uncontrolled (≤ 19)	15	68.2%	10	45.5%
Controlled (> 19)	7	31.8%	12	54.5%

Table 40. Asthma Control Scale Results Aggregated Across Scales, by Timepoint

	Aggregate Visit 1 (N=161)		Aggregate Visit 3 (N=161)	
	n	%	n	%
Uncontrolled	118	73.3%	89	55.3%
Controlled	43	26.7%	72	44.7%

Environmental Assessment – Caregiver Questions

Table 41. Location of Environmental Assessment, by Timepoint

	Aggregate Visit 1 (N=161)		Aggregate Visit 3 (N=161)	
	n	%	n	%
Same location as Home Visit 1	--	--	152	94.4%
Different location from Home Visit 1	--	--	9	5.6%

Table 42. Reported Smoking Inside Home in Past 7 Days, by Timepoint

	Aggregate Visit 1 (N=161)		Aggregate Visit 3 (N=161)	
	n	%	n	%
None	143	88.8%	147	91.3%
1 to 2 days	2	1.2%	3	1.9%
3 to 6 days	2	1.2%	2	1.2%
Every day	14	8.7%	8	5.0%
Don't know/Not sure	0	0.0%	1	0.6%

Table 43. Reported Tobacco Smoke from Outside Home in Past 7 Days, by Timepoint

	Aggregate Visit 1 (N=161)		Aggregate Visit 3 (N=161)	
	n	%	n	%
None	97	60.2%	106	65.8%
1 to 2 days	17	10.6%	14	8.7%
3 to 6 days	6	3.7%	3	1.9%
Every day	38	23.6%	36	22.4%
Don't know/Not sure	3	1.9%	2	1.2%

Table 44. Reported Mold or Musty Odor Inside Home in Past 30 Days, by Timepoint

	Aggregate Visit 1 (N=161)		Aggregate Visit 3 (N=161)	
	n	%	n	%
Yes	32	19.9%	11	6.8%
No	122	75.8%	148	91.9%
Don't know/Not sure	7	4.3%	2	1.2%

Table 45. Reported Furry or Feathered Pets Inside Home, by Timepoint

	Aggregate Visit 1 (N=161)		Aggregate Visit 3 (N=161)	
	n	%	n	%
Yes	52	32.3%	53	32.9%
No	109	67.7%	108	67.1%

Table 46. Reported Cockroaches Inside Home Currently or Within Past 3 Months, by Timepoint

	Aggregate Visit 1 (N=161)		Aggregate Visit 3 (N=161)	
	n	%	n	%
Yes, within the past month	43	26.7%	27	16.8%
Yes, within past 3 months but not now	6	3.7%	10	6.2%
No problem within past 3 months	104	64.6%	119	73.9%
Don't know/Not sure	8	5.0%	5	3.1%

Table 47. Reported Rodents Inside Home Currently or Within Past 3 Months, by Timepoint

	Aggregate Visit 1 (N=161)		Aggregate Visit 3 (N=161)	
	n	%	n	%
Yes, within the past month	44	27.3%	31	19.3%
Yes, within past 3 months but not now	10	6.2%	15	9.3%
No problem within past 3 months	99	61.5%	107	66.5%
Don't know/Not sure	8	5.0%	8	5.0%

Table 48. Reported Presence of Chemicals Inside Home, by Timepoint

	Aggregate Visit 1 (N=161)		Aggregate Visit 3 (N=161)	
	n	%	n	%
Cleaning products that contain bleach or ammonia	128	79.5%	81	50.3%
Paint products, solvents, glue	19	11.8%	4	2.5%
Air fresheners, scented candles, incense	103	64.0%	74	46.0%
Pesticides	20	12.4%	8	5.0%
None of the above	22	13.7%	61	37.9%
Don't know/Not sure	3	1.9%	2	1.2%

Environmental Assessment – Environmental Asthma Factor Composite Score

Table 49. Presence of Environmental Asthma Factors, by Timepoint

	Aggregate Visit 1 (N=161)		Aggregate Visit 3 (N=161)	
	n	%	n	%
Dust (1 Observation per Room)				
Yes	92	57.1%	86	53.4%
No	69	42.9%	75	46.6%
Mold (1 Caregiver Question; 3 Observations per Room)				
Yes	78	48.4%	43	26.7%
No	83	51.6%	118	73.3%
Pest (2 Caregiver Questions; 2 Observations per Room)				
Yes	76	47.2%	57	35.4%
No	85	52.8%	104	64.6%
Smoke (2 Caregiver Questions; 2 Observations per Room)				
Yes	75	46.6%	63	39.1%
No	86	53.4%	98	60.9%
Pet (1 Caregiver Question)				
Yes	52	32.3%	53	32.9%
No	109	67.7%	108	67.1%
Chemical (1 Caregiver Question)				
Yes	136	84.5%	98	60.9%
No	25	15.5%	63	39.1%

Table 50. Mean Environmental Asthma Factor Composite Score, by Timepoint

	Aggregate Visit 1 (N=161)	Aggregate Visit 3 (N=161)
Mean (Min, Max)	3.2 (0, 6)	2.5 (0, 6)

APPENDIX B.

Caregiver Questionnaire – Asthma Action Plan

Table 51. Participants Provided with Written Action Plan by Doctor or Other Health Professional, as Confirmed by CHW, by Timepoint

	Aggregate Visit 1 (N=86)		Aggregate Visit 3 (N=86)		Aggregate Follow-up (N=86)	
	n	%	n	%	n	%
No written plan	14	16.3%	9	10.5%	14	16.3%
Written plan, and confirmed by CHW	47	54.7%	64	74.4%	58	67.4%
Written plan, but not confirmed by CHW	25	29.1%	13	15.1%	14	16.3%

Table 52. Reported Use of Written Action Plan to Decide on Medications, by Timepoint

	Aggregate Visit 1 (N=86)		Aggregate Visit 3 (N=86)		Aggregate Follow-up (N=86)	
	n	%	n	%	n	%
Yes	40	46.5%	61	70.9%	62	72.1%
No	43	50.0%	24	27.9%	20	23.3%
I don't know	3	3.5%	1	1.2%	4	4.7%

Table 53. Reported Number of Work/School Days Caregiver(s) Missed Due to Child's Asthma in Past 6 Months, by Timepoint

	Aggregate Visit 1 (N=86)		Aggregate Visit 3 (N=86)		Aggregate Follow-up (N=86)	
	n	%	n	n	n	%
None	28	32.6%	35	40.7%	44	51.2%
1 to 3	22	25.6%	26	30.2%	26	30.2%
4 to 6	13	15.1%	13	15.1%	10	11.6%
7 to 10	15	17.4%	8	9.3%	2	2.3%
11 or more	8	9.3%	4	4.7%	4	4.7%
Median	2.5		1		0	

Table 54. Reported Number of Childcare/School Days Child Missed Due to Asthma in Past 6 Months, by Timepoint

	Aggregate Visit 1 (N=86)		Aggregate Visit 3 (N=86)		Aggregate Follow-up (N=86)	
	n	%	n	%	n	%
None	11	12.8%	22	25.6%	35	40.7%
1 to 3	19	22.1%	19	22.1%	20	23.3%
4 to 6	13	15.1%	22	25.6%	17	19.8%
7 to 10	13	15.1%	10	11.6%	3	3.5%
11 or more	18	20.9%	8	9.3%	7	8.1%
Not applicable	12	14.0%	5	5.8%	4	4.7%
Median	6		4		2	

Table 55. Reported Child Receiving Flu Shot in Past 12 Months, by Timepoint

	Aggregate Visit 1 (N=86)		Aggregate Visit 3 (N=86)		Aggregate Follow-up (N=86)	
	n	%	n	%	n	%
Yes	55	64.0%	57	66.3%	61	70.9%
No	29	33.7%	27	31.4%	24	27.9%
I don't know	2	2.3%	2	2.3%	1	1.2%

NOTE: The “No” category includes those who responded “No” or “No – egg allergy”

Asthma Control Scales

Table 56. Of Children Under Age 4, Child’s TRACK Scale Results, by Timepoint

	Aggregate Visit 1 (N=24)		Aggregate Visit 3 (N=23)		Aggregate Follow-up (N=17)	
	n	%	n	%	n	%
Uncontrolled (< 80)	20	83.3%	17	73.9%	8	47.1%
Controlled (≥ 80)	4	16.7%	6	26.1%	9	52.9%

*Note: difference in sample size due to use of different Asthma scale between timepoints

Table 57. Of Children Ages 4 to 11, Child's ACT 4-11 Scale Results, by Timepoint

	Aggregate Visit 1 (N=53)		Aggregate Visit 3 (N=54)		Aggregate Follow-up (N=60)	
	n	%	n	%	n	%
Uncontrolled (≤ 19)	32	60.4%	24	44.4%	24	40.0%
Controlled (> 19)	21	39.6%	30	55.6%	36	60.0%

*Note: difference in sample size due to use of different Asthma scale between timepoints

Table 58. Of Children Ages 12 and Older, Child's ACT 12+ Scale Results, by Timepoint

	Aggregate Visit 1 (N=9)		Aggregate Visit 3 (N=9)		Aggregate Follow-up (N=9)	
	n	%	n	%	n	%
Uncontrolled (≤ 19)	7	77.8%	5	55.6%	4	44.4%
Controlled (> 19)	2	22.2%	4	44.4%	5	55.6%

Table 59. Asthma Control Scale Results Aggregated Across Scales, by Timepoint

	Aggregate Visit 1 (N=86)		Aggregate Visit 3 (N=86)		Aggregate Follow-up (N=86)	
	n	%	n	%	n	%
Uncontrolled	59	68.6%	46	53.5%	36	41.9%
Controlled	27	31.4%	40	46.5%	50	58.1%

Environmental Assessment – Caregiver Questions

Table 60. Location of Environmental Assessment, by Timepoint

	Aggregate Visit 1 (N=86)		Aggregate Visit 3 (N=86)		Aggregate Follow-up (N=86)	
	n	%	n	%	n	%
Same location as Home Visits 1 & 3	--	--	--	--	82	95.3%
Different location from Home Visits 1 & 3	--	--	--	--	4	4.7%

Table 61. Reported Smoking Inside Home in Past 7 Days, by Timepoint

	Aggregate Visit 1 (N=86)		Aggregate Visit 3 (N=86)		Aggregate Follow-up (N=86)	
	n	%	n	%	n	%
None	77	89.5%	79	91.9%	84	97.7%
1 to 2 days	2	2.3%	2	2.3%	0	0.0%
3 to 6 days	2	2.3%	2	2.3%	1	1.2%
Every day	5	5.8%	2	2.3%	1	1.2%
Don't know/Not sure	0	0.0%	1	1.2%	0	0.0%

Table 62. Reported Tobacco Smoke from Outside Home in Past 7 Days, by Timepoint

	Aggregate Visit 1 (N=86)		Aggregate Visit 3 (N=86)		Aggregate Follow-up (N=86)	
	n	%	n	%	n	%
None	63	73.3%	68	79.1%	63	73.3%
1 to 2 days	6	7.0%	4	4.7%	9	10.5%
3 to 6 days	3	3.5%	0	0.0%	4	4.7%
Every day	11	12.8%	13	15.1%	10	11.6%
Don't know/Not sure	3	3.5%	1	1.2%	0	0.0%

Table 63. Reported Mold or Musty Odor Inside Home in Past 30 Days, by Timepoint

	Aggregate Visit 1 (N=86)		Aggregate Visit 3 (N=86)		Aggregate Follow-up (N=86)	
	n	%	n	%	n	%
Yes	18	20.9%	9	10.5%	10	11.6%
No	63	73.3%	75	87.2%	76	88.4%
Don't know/Not sure	5	5.8%	2	2.3%	0	0.0%

Table 64. Reported Furry or Feathered Pets Inside Home, by Timepoint

	Aggregate Visit 1 (N=86)		Aggregate Visit 3 (N=86)		Aggregate Follow-up (N=86)	
	n	%	n	%	n	%
Yes	24	27.9%	27	31.4%	24	27.9%
No	62	72.1%	59	68.6%	62	72.1%

Table 65. Reported Cockroaches Inside Home Currently or Within Past 3 Months, by Timepoint

	Aggregate Visit 1 (N=86)		Aggregate Visit 3 (N=86)		Aggregate Follow-up (N=86)	
	n	%	n	%	n	%
	Yes, within the past month	17	19.8%	13	15.1%	10
Yes, within past 3 months but not now	5	5.8%	6	7.0%	4	4.7%
No problem within past 3 months	58	67.4%	63	73.3%	69	80.2%
Don't know/Not sure	6	7.0%	4	4.7%	3	3.5%

Table 66. Reported Rodents Inside Home Currently or Within Past 3 Months, by Timepoint

	Aggregate Visit 1 (N=86)		Aggregate Visit 3 (N=86)		Aggregate Follow-up (N=86)	
	n	%	n	%	n	%
	Yes, within the past month	21	24.4%	16	18.6%	12
Yes, within past 3 months but not now	7	8.1%	10	11.6%	4	4.7%
No problem within past 3 months	51	59.3%	53	61.6%	68	79.1%
Don't know/Not sure	7	8.1%	7	8.1%	2	2.3%

Table 67. Reported Presence of Chemicals Inside Home, by Timepoint

	Aggregate Visit 1 (N=86)		Aggregate Visit 3 (N=86)		Aggregate Follow-up (N=86)	
	n	%	n	n	n	%
	Cleaning products that contain bleach or ammonia	61	70.9%	42	48.8%	44
Paint products, solvents, glue	11	12.8%	2	2.3%	6	7.0%
Air fresheners, scented candles, incense	54	62.8%	38	44.2%	39	45.3%
Pesticides (that don't make asthma worse but are toxic)	10	11.6%	5	5.8%	8	9.3%
None of the above	15	17.4%	34	39.5%	35	40.7%
Don't know/Not sure	2	2.3%	1	1.2%	0	0.0%