Heat-Related Impacts of the Healthy Homes Pilot Program in Maricopa County: 2021, 2022, and 2023

Report prepared by
Three^3, Inc.
Foundation for Senior Living (FSL)

Report prepared for
Arizona Public Service (APS)

February 18, 2024

2021 and 2022 Project Partners:

Additional 2021 Project Partners:

Introduction

This report summarizes results from an on-going, independent evaluation of a Healthy Homes Pilot Program delivered in Maricopa County, Arizona. This Healthy Homes Pilot Program is exclusively an emergency HVAC repair/replacement program provided to eligible households in Maricopa County by the Foundation for Senior Living (FSL). The 2021 cooling season pilot program was funded by Arizona Public Service (APS), PhoenixIDA, and Phoenix Community Development & Investment Corporation (CDIC)–the 2022 and 2023 cooling season pilots were funded by APS only. All recipients of the emergency HVAC pilot program were asked to complete a 10–15-minute impact survey both before and after the service ('intervention').

The survey posed questions related to the following themes:

- Respondent demographics
- Home occupancy
- Dwelling comfort and safety
- Select health conditions (i.e., heat stress, asthma, chronic obstructive pulmonary disorder (COPD), and arthritis) and related medical encounters
- General health, mental health, and sleep
- Energy burden

The baseline surveys were administered by FSL pre-intervention (between July through September), and the follow-up surveys were administered in October or November; in each of the 2021, 2022, and 2023 seasons. Across both cooling season samples, 128 respondents completed the baseline survey; 94 of those completed the follow-up survey.

Data analysis was conducted using the Statistical Package for Social Sciences (SPSS) software. The study team conducted frequencies, crosstabulations, and tests of statistical significance using the McNemars Test, Wilkoxon Signed Rank Test, and Paired-Samples t-Test when appropriate. Three[3], Inc., a non-profit research organization located in Tennessee, provides technical support to FSL with survey design, data analysis and dissemination of results.[1]

In this report, observed outcomes and impacts of the Healthy Homes Pilot Program are presented in three ways within each subsection to capture differences between the 2021, 2022, and 2023 cooling seasons and with all years combined for aggregate findings.

[1] http://www.threecubed.org/

Results

1. Respondent Demographics

The total number of respondents that completed both the baseline and follow up survey was 94; 39 in the 2021 sample, 18 in the 2022 sample, and 37 in the 2023 sample.

Cooling Season 2021
Including all respondents that completed both surveys in 2021, the average age was 68 (ranging from 32 to 95) with the majority identifying as female (77%). Seventy percent identified as White, 19% as Hispanic or Latino origin, and 9% as Black or African American. Ten percent had served on active duty in the military at some point in time. (Table 1)

Cooling Season 2022
A total of 34 households completed the baseline survey in 2022. Including all respondents that completed both surveys in 2022 (n=18), the average age was 63 with over 70% of the sample identifying as female and White. Twenty two percent identified as being of Hispanic or Latino origin, and 11% as Black or African American. No households in the 2022 sample that completed both surveys reported someone having been on active duty in the military at some point in time (Table 1).

Cooling Season 2023
A total of 42 households completed the baseline survey in 2023. Including all respondents that completed both surveys in 2022 (n=37), the average age was 68 with over 65% of the sample identifying as female and 74% identifying as White. Nineteen percent identified as being of Hispanic or Latino origin, and 16% as Black or African American. Sixteen percent serve or had served on active duty in the military at some point in time (Table 1).

Cooling Seasons 2021, 2022, and 2023 Combined
Participant demographics were analyzed for all individuals who completed the baseline survey in either 2021, 2022, or 2023. The percentage of individuals who identified as Hispanic or Latino and completed both rounds of the survey (pre- and post-intervention) dropped by eight percent (from the pre-intervention group); suggesting members of these groups were not interested or were unable to complete the second survey.

Table 1. Demographics of Aggregated (Full) Sample

Demographic	2021 Paired Sample (n=39)	2022 Paired Sample (n=18)	2023 Paired Sample (n=37)	Paired Sample All years Combined (n=94)	Full Sample All years Combined (n=128)
Age (mean)	68	63	68	67	67
Female	80%	72%	65%	72%	72%
White or Caucasian	70%	71%	73%	71%	66%
Hispanic or Latino/a	18%	22%	19%	19%	27%

Black or African American	8%	11%	16%	12%	12%
American Indian or Alaska Native	3%	-	-	1%	1%
Asian or Asian American	3%	-	-	1%	2%
Native Hawaiian or other Pacific Islander	-	6%	-	1%	1%
Prefer not to answer	3%	-	3%	2%	2%
Other (Israeli)	-	-	-	-	1%
Served in the U.S. Armed Forces, Reserves, or National Guard	13%	-	16%	12%	10%

2. Home Occupancy

At baseline, the majority of households (80% of the 2021 sample, 67% of the 2022, and 77% of the 2023 sample) reported being inside their homes most of the day. Across the pooled sample for both cooling seasons, the percentage of households reported being away from their home reduced by 8%. It should be noted that the COVID-19 pandemic likely impacted the amount of time people spent inside their homes during 2021 (Table 2-5).

Table 2. Home Occupancy Behavior 2021

Survey Question/Paired Samples (n=39)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)[1]
Over the past 30 days, did you spend more time…?				
Inside your home during the day	80%	80%	0%	(1.000)
Away from your home during the day	15%	5%	-10%	(.219)
Equal amounts of time at home and away during the day	5%	15%	10%	(.289)

[1] Change (+/-) was found to be statistically significant at the * p< .05, ** p<.01, or *** p< .001 level in a McNemars Test or Wilkoxon Signed Rank Test comparing pre-/post- intervention responses between paired samples (same respondent).

Table 3. Home Occupancy Behavior 2022

Survey Question/Paired Samples (n=18)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)[1]
Over the past 30 days, did you spend more time…?				
Inside your home during the day	67%	56%	-11%	(.625)
Away from your home during the day	6%	11%	5%	(1.000)
Equal amounts of time at home and away during the day	27%	33%	6%	(1.000)

[1] Change (+/-) was found to be statistically significant at the * p< .05, ** p<.01, or *** p< .001 level in a McNemars Test or Wilkoxon Signed Rank Test comparing pre-/post- intervention responses between paired samples (same respondent).

Table 4. Home Occupancy Behavior 2023

Survey Question/Paired Samples (n=35)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)[1]
Over the past 30 days, did you spend more time…?				
Inside your home during the day	77%	91%	14%	(.180)
Away from your home during the day	11%	0%	-11%	(.125)
Equal amounts of time at home and away during the day	11%	9%	-2%	(1.000)

[1] Change (+/-) was found to be statistically significant at the * p< .05, ** p<.01, or *** p< .001 level in a McNemars Test or Wilkoxon Signed Rank Test comparing pre-/post- intervention responses between paired samples (same respondent).

Table 5. Home Occupancy Behavior 2021, 2022, and 2023 Combined

Survey Question/Paired Samples (n=92)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)[1]
Over the past 30 days, did you spend more time…?				
Inside your home during the day	76%	79%	+3%	(.678)
Away from your home during the day	12%	4%	-8%	(.092)
Equal amounts of time at home and away during the day	12%	16%	+4%	(.481)

[1] Change (+/-) was found to be statistically significant at the * p< .05, ** p<.01, or *** p< .001 level in a McNemars Test or Wilkoxon Signed Rank Test comparing pre-/post- intervention responses between paired samples (same respondent).

3. Dwelling Comfort and Safety

One hundred percent of recipients in the 2021 and 2022 reported that their homes were at 'comfortable' indoor temperatures during the summer post-intervention – 94% of the 2023 sample reported being comfortable post-intervention (Tables 6-9). Of those households that completed both surveys, 69% of the 2021 sample, 89% of the 2022, and 82% of the 2023 sample reported being hot or very hot inside their homes pre-intervention. Differences from pre- to post-intervention were found to be statistically significant across all samples and with samples combined. Post-intervention reports of unsafe temperatures significantly decreased by 61% in the combined sample with no households reporting being at unsafe or unhealthy temperatures after the intervention. Pre-intervention frequency of temporary relocation due to heat dropped – significantly – from 20% to 2% in the combined samples.

Table 6. Dwelling Comfort and Safety 2021

Survey Question/Paired Samples (n=39)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)[1]
Over the past 30 days…				
Which of the following describes the indoor temperature of your home? (% Yes)				
Comfortable	31%	100%	+69%	***(<.001)
Hot	46%	0%	-46%	***(<.001)
Very hot	23%	0%	-23%	***(<.001)
Has your home been at a temperature that you felt was unsafe or unhealthy? (% Yes)	47%	0%	-47%	***(<.001)
Did you have to temporarily move out of your home because your home was too hot? (% Yes)	18%	0%	-18%	**(0.008)

[1] Change (+/-) was found to be statistically significant at the * p< .05, ** p<.01, or *** p< .001 level in a McNemars Test or Wilkoxon Signed Rank Test comparing pre-/post- intervention responses between paired samples (same respondent).

Table 7. Dwelling Comfort and Safety 2022

Survey Question/Paired Samples (n=17)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)[1]
Over the past 30 days…				
Which of the following describes the indoor temperature of your home? (% Yes)				
Comfortable	11%	100%	+89%	***(<.001)
Hot	56%	0%	-56%	***(<.001)
Very hot	33%	0%	-33%	***(<.001)
Has your home been at a temperature that you felt was unsafe or unhealthy? (% Yes)	56%	0%	-56%	**(<.004)
Did you have to temporarily move out of your home because your home was too hot? (% Yes)	12%	0%	-12%	(0.500)

Table 8. Dwelling Comfort and Safety 2023

Survey Question/Paired Samples (n=17)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)[1]
Over the past 30 days…				
Which of the following describes the indoor temperature of your home? (% Yes)				
Comfortable	17%	94%	+77%	***(<.001)
Hot	31%	3%	-28%	**(<.006)
Very hot	51%	3%	-48%	***(<.001)
Has your home been at a temperature that you felt was unsafe or unhealthy? (% Yes)	77%	0%	-77%	***(<.001)
Did you have to temporarily move out of your home because your home was too hot? (% Yes)	25%	6%	-19%	(.065)

Table 9. Dwelling Comfort and Safety 2021, 2022, and 2023 Combined

Survey Question/Paired Samples (n=39)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)[1]
Over the past 30 days…				
Which of the following describes the indoor temperature of your home? (% Yes)				
Comfortable	22%	98%	+76%	***(<.001)
Hot	42%	1%	-41%	***(<.001)
Very hot	36%	1%	-35%	***(<.001)
Has your home been at a temperature that you felt was unsafe or unhealthy? (% Yes)	61%	0%	-61%	***(<.001)
Did you have to temporarily move out of your home because your home was too hot? (% Yes)	20%	2%	-18%	***(<.001)

An overwhelming majority of households reported that there were times inside their home that they could not get enough rest or sleep because their homes were too hot pre-intervention (Table 10).

Table 10. Impacts of Heat on Sleep 2021, 2022, and 2023

Survey Question/Full Samples	2021 (n=51)	2022 (n=33)	2023 (n=42)	2021, 2022, + 2023 Combined (n=128)
Was there ever a time living in this home that you did not get enough rest or sleep because it was too hot inside? (% Yes)	77%	88%	86%	83%

4. Heat Stress – Medical Encounters

Pre-intervention, responses from each of the summer samples indicated that several people needed to seek medical treatment because their home was too hot. The emergency department was the most common care setting people went to for treatment. Post-intervention, there was only one report of a medical encounter due to exposure to hot indoor temperatures. (Tables 11-14).

Table 11. Heat Stress – Medical Encounters 2021

Survey Question/Paired Samples (n=39)	**Pre-Intervention**	**Post-Intervention**	**Change (+/-)**
Over the past 30 days…			
Has anyone in the household had to seek medical treatment because your home was too HOT? (# Yes)	3	0	-3
***If yes,* [to seeking medical treatment because home was too hot] *which care setting?* (Full sample; N=52)**	**Pre-Intervention**	**Post-Intervention**	**Change (+/-)**
Office Visit	0	0	-
Emergency Department (ED)	1	0	-1
Hospital	1	0	-1
Other	1	0	-1

Table 12. Heat Stress – Medical Encounters 2022

Survey Question/Paired Samples (n=18)	**Pre-Intervention**	**Post-Intervention**	**Change (+/-)**
Over the past 30 days…			
Has anyone in the household had to seek medical treatment because your home was too HOT? (# Yes)	5	0	0
***If yes,* [to seeking medical treatment because home was too hot] *which care setting?* (Full sample; N=52)**	**Pre-Intervention**	**Post-Intervention**	**Change (+/-)**
Office Visit	3	0	-3
Emergency Department (ED)	1	0	-1
Hospital	0	0	-
Other	1	0	-1

Table 13. Heat Stress – Medical Encounters 2023

Survey Question/Paired Samples (n=18)	Pre-Intervention	Post-Intervention	Change (+/-)
Over the past 30 days…			
Has anyone in the household had to seek medical treatment because your home was too HOT? (# Yes)	7	1	-6
***If yes,* [to seeking medical treatment because home was too hot] *which care setting?* (Full sample; N=52)**	**Pre-Intervention**	**Post-Intervention**	**Change (+/-)**
Office Visit	1	0	-1
Emergency Department (ED)	5	0	-5
Hospital	2	0	-2
Other	3	0	-3

At baseline (pre-intervention), across all samples, 14% of households reported that someone in the home had to seek medical attention because their home was too hot (Table 14). Only 1% of respondents reported someone in the home seeking medical attention because their homes were too hot. Across all summer samples, post-intervention, there were eight fewer medical encounters reported.

Table 14. Heat Stress – Medical Encounters 2021, 2022, and 2023 Combined

Survey Question/Paired Samples (n=52)	Pre-Intervention	Post-Intervention	Change (+/-)
Over the past 30 days…			
Has anyone in the household had to seek medical treatment because your home was too HOT? (# Yes)	9	1	-8
***If yes,* [to seeking medical treatment because home was too hot] *which care setting?* (Full sample; N=52)**	**Pre-Intervention**	**Post-Intervention**	**Change (+/-)**
Office Visit	4	0	-4
Emergency Department (ED)	7	0	-7
Hospital	3	0	-3
Other	5	1	-4

5. Asthma Prevalence and Medical Encounters

Including all respondents from the 2021, 2022, and 2023 cooling seasons, 34% reported having been diagnosed (at any point in their lives) with asthma – 25% reported that they "still have asthma" (n=32). Reductions in the frequency of individuals experiencing asthma symptoms 'less than one week ago' were observed pre- to post-interventions; but not at statistically significant rates. For the matched pair sample for all years combined, only a few medical encounters for asthma were reported making it difficult to detect patterns or impacts on this outcome attributable to the program. It should be noted that for personal illnesses, such as asthma, COPD, and arthritis, best practice is to analyze responses from the same individual (i.e., matched pairs, paired analysis). Seventy-five percent of respondents reported that the person in their home with the worst asthma has symptoms that worsen with increased heat (Tables 15-20).

Table 15. Asthma Prevalence 2021, 2022, and 2023

Survey Question/Full Samples (n=128)	2021	2022	2023	2021, 2022 + 2023 Combined
Have you or anyone in the home ever been told by a doctor or health professional that you or they have asthma?	47% (n=24)	29% (n=10)	22% (n=9)	34% (n=43)
Do you or they still have asthma?	35% (n=18)	18% (n=6)	20% (n=8)	25% (n=32)

Table 16. Asthma Symptoms and Medical Encounters 2021

Survey Question/Paired Samples (n=12)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)
How long has it been since that person [with the worst asthma] last had any symptoms ['flare-ups'] *of asthma?* (% Yes) (n=12)				
Less than one week	68%	42%	-26%	(.375)
1 week to 3 months	0%	58%	+58%	(1.000)
3 months +	8%	17%	+9%	(1.000)
Over the past 30 days…				
Has that person ever had to go to seek urgent medical treatment because of worsening symptoms of asthma?	10%	0%	-10%	(1.000)
Number of Medical Encounters for Worsening Asthma Symptoms (# of encounters)	(1 'Other' visit)	(1 Urgent Care Visit)	-	-

Table 17. Asthma Symptoms and Medical Encounters 2022

Survey Question/Paired Samples (n=4)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)
How long has it been since that person [with the worst asthma] last had any symptoms ['flare-ups'] *of asthma?*				
Less than one week	25%	0%	-25%	(1.000)
1 week to 3 months	0%	100%	50%	(.500)
3 months +	50%	25%	-25%	(1.000)
Over the past 30 days…				
Has that person ever had to go to seek urgent medical treatment because of worsening symptoms of asthma?	33%	67%	34%	(1.000)
Number of Medical Encounters for Worsening Asthma Symptoms (# of encounters)	(1 ED Visit)	(1 ED visit; 1 Urgent Care Visit)	+1	-

Table 18. Asthma Symptoms and Medical Encounters 2023

Survey Question/Paired Samples (n=3)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)
How long has it been since that person [with the worst asthma] last had any symptoms ['flare-ups'] *of asthma?*				
Less than one week	33%	0%	-33%	(1.000)
1 week to 3 months	0%	33%	+33%	(.500)
3 months +	67%	33%	-33%	(1.000)
Over the past 30 days…				
Has that person ever had to go to seek urgent medical treatment because of worsening symptoms of asthma?	17%	0%	-17%	(1.000)
Number of Medical Encounters for Worsening Asthma Symptoms (# of encounters)	(1 ED Visit)	-	-1	(1.000)

Table 19. Asthma Symptoms and Medical Encounters 2021, 2022, and 2023

Survey Question/Paired Samples (n=19)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)
How long has it been since that person [with the worst asthma] last had any symptoms ['flare-ups'] *of asthma?*				
Less than one week	53%	26%	-25%	(.125)
1 week to 3 months	0%	50%	25%	(.219)
3 months +	19%	19%	9%	(1.000)
Over the past 30 days…				
Has that person ever had to go to seek urgent medical treatment because of worsening symptoms of asthma? (n=16)	16%	11%	-5%	(1.000)
Number of Medical Encounters for Worsening Asthma Symptoms (# of encounters)	(2 ED and 1 Other Visit)	(2 Urgent Care, 1 ED visit)	-	-

Table 20. Asthma Symptoms Worsen with Heat 2021, 2022, and 2023

Survey Question/Full Samples (n=39)	2021	2022	2023	2021, 2022 + 2023 Combined
Does that person's symptoms of asthma seem to worsen when they are hot?	81%	75%	75%	78%

6. COPD+ Prevalence and Medical Encounters

Twenty-two of respondents reported they or someone else in the home had been diagnosed (at any point in their lives) with COPD, emphysema, or chronic bronchitis. Although an overwhelming majority (83%) stated that their or the other person's symptoms of respiratory illness worsen with increased heat, only a small, insignificant change (for 2021, 2022, and 2023 samples combined) in medical encounters for symptoms related to shortness of breath, bronchitis or COPD was observed post-intervention (Table 21-21).

Table 21. COPD+ Prevalence 2021, 2022, and 2023

Survey Question/Full Samples (n=128)	2021	2022	2023	2021, 2022 + 2023 Combined
Have you or anyone in the home ever been told by a doctor or health professional that you have COPD, emphysema, or chronic bronchitis?	28%	17%	17%	22%

Table 22. COPD+ Medical Encounters 2021

Survey Question/Paired Samples (n=8)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)
Over the past 30 days…				
Other than a routine visit, has that person ever had to seek medical treatment for symptoms related to shortness of breath, bronchitis, or other COPD or emphysema flare-ups?	13%	25%	+12%	(1.000)

Table 23. COPD+ Medical Encounters 2022

Survey Question/Paired Samples (n=3)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)
Over the past 30 days…				
Other than a routine visit, has that person ever had to seek medical treatment for symptoms related to shortness of breath, bronchitis, or other COPD or emphysema flare-ups?	33%	0%	-33%	(1.000)

Table 24. COPD+ Medical Encounters 2023

Survey Question/Paired Samples (n=3)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)
Over the past 30 days…				
Other than a routine visit, has that person ever had to seek medical treatment for symptoms related to shortness of breath, bronchitis, or other COPD or emphysema flare-ups?	27%	14%	-13%	(1.000)

Table 25. COPD+ Medical Encounters 2021, 2022, and 2023 combined

Survey Question/Paired Samples (n=11)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)
Over the past 30 days…				
Other than a routine visit, has that person ever had to seek medical treatment for symptoms related to shortness of breath, bronchitis, or other COPD or emphysema flare-ups?	22%	17%	-5%	(1.000)

Table 26. COPD+ Symptoms Worsen When Hot 2021, 2022, and 2023

Survey Question/Full Samples	2021	2022	2023	2021, 2022 + 2023 Combined
Does that person's symptoms of respiratory illness seem to worsen when they are hot?	92%	75%	78%	83%

7. Arthritis+ - Prevalence and Medical Encounters

Close to 60% of participating households in the 2021 and 2022 samples, and 80% of the 2023 sample reported that they or someone else in the home has ever been diagnosed with some form of arthritis, rheumatoid or osteoarthritis, gout, lupus, fibromyalgia, or Complex Regional Pain Syndrome (i.e., arthritis+). When asked how long ago the person with arthritis had had symptoms, the frequency in responses reporting symptoms less than one week ago reduced by 13% in the combined sample. A 37% decrease in reports of seeking medical care for worsening arthritis symptoms was reported post-intervention. Seventy-six percent of respondents across all samples reported (at baseline) that the symptoms of the person in their home with the worst arthritis worsen when they are hot. (Tables 27-31).

Table 27. Arthritis+ - Prevalence and Medical Encounters 2021

Survey Question/Paired Samples (n=25)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)
Have you or anyone else in the home ever been told by a doctor or other health professional that you have some form of arthritis, rheumatoid or osteoarthritis, gout, lupus, fibromyalgia, or Complex Regional Pain Syndrome? (Full sample, n=52)	65%			
How long has it been since that person last had any symptoms of arthritis? (n=25)				
Less than one week	84%	80%	-4%	(1.000)
1 week to 3 months	8%	8%	0%	No Change
3 months +	8%	12%	4%	(1.000)
Over the past 30 days…				
Did that person see a doctor, nurse, or other health professional for urgent treatment of worsening arthritis symptoms?	50%	4%	-46%	*** (<.001)

Table 28. Arthritis+ - Prevalence and Medical Encounters 2022

Survey Question/Paired Samples (n=8)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)
Have you or anyone else in the home ever been told by a doctor or other health professional that you have some form of arthritis, rheumatoid or osteoarthritis, gout, lupus, fibromyalgia, or Complex Regional Pain Syndrome? (Full sample, n=32)	50%			
How long has it been since that person last had any symptoms of arthritis? (n=8)				
Less than one week	88%	50%	-23%	(.250)
1 week to 3 months	0%	0%	0%	No Change
3 months +	12%	50%	38%	(.250)
Over the past 30 days…				
Did that person see a doctor, nurse, or other health professional for urgent treatment of worsening arthritis symptoms?	50%	13%	-37%	(0.250)

Table 29. Arthritis+ - Prevalence and Medical Encounters 2023

Survey Question/Paired Samples (n=31)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)
Have you or anyone else in the home ever been told by a doctor or other health professional that you have some form of arthritis, rheumatoid or osteoarthritis, gout, lupus, fibromyalgia, or Complex Regional Pain Syndrome? (Full sample, n=42)	80%			
How long has it been since that person last had any symptoms of arthritis? (n=31)				
Less than one week	77%	64%	-13%	(.508)
1 week to 3 months	9%	9%	0%	No Change
3 months +	14%	27%	+13%	(.453)
Over the past 30 days…				
Did that person see a doctor, nurse, or other health professional for urgent treatment of worsening arthritis symptoms?	35%	12%	-23%	(.289)

Table 30. Arthritis+ - Prevalence and Medical Encounters 2021, 2022, and 2023

Survey Question/Paired Samples (n=33)	Pre-Intervention	Post-Intervention	Change (+/-)	(p-value)
Have you or anyone else in the home ever been told by a doctor or other health professional that you have some form of arthritis, rheumatoid or osteoarthritis, gout, lupus, fibromyalgia, or Complex Regional Pain Syndrome? (Full sample, n=81)	66%			
How long has it been since that person last had any symptoms of arthritis? (Paired sample, n=55)				
Less than one week	82%	69%	-13%	(.143)
1 week to 3 months	7%	7%	0%	No Change
3 months +	11%	24%	13%	(.118)
Over the past 30 days…				
Did that person see a doctor, nurse, or other health professional for urgent treatment of worsening arthritis symptoms?	45%	8%	-37%	*** (<.001)

When asked if the symptoms of individual with some form of arthritis worsen when they are hot, an overwhelming majority reported that they do (77% for the combined samples).

Table 31. Arthritis+ Symptoms Worsen When Hot 2021, 2022 and 2023

Survey Question/Full Samples	2021	2022	2023	2021 + 2022 Combined
Does that person's symptoms of arthritis seem to worsen when they are hot?	81%	69%	75%	76%

8. Changes in General Sleep, Physical Health, and Mental Health

Post-intervention, improvements in rest and sleep were observed along with statistically significant improvements in mental health. This pattern was observed in each of the 2021, 2022 and 2023 samples, as well as the 2021, 2022, and 2023 cooling season samples combined. Post-intervention there was a mean increase in about 8 'good' mental health days in the last month for this pooled sample. The mean number of days people reported not getting enough rest or sleep decreased significantly in combined samples: from approximately 16 days to 7 days. A statistically significant decrease (5 days) in the mean number of days poor physical or mental health kept individuals from doing their usual activities, such as self-care, work or recreation, was observed in the combined cooling season samples. (Table 32-28).

Table 32. General Health, Mental Health, and Sleep 2021

Survey Question/Paired Samples (n=39)	Pre-Intervention (n=39)	Post-Intervention (n=39)	Change (+/-)	(p-value) [1]
During the past 30 days, for about how many days do you feel you did not get enough rest or sleep? (mean # of days)	12.5	10.3	-2.2	(0.251)
Thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good? (mean # of days)	13.3	4.5	-8.8	***(<.001)
During the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation? (mean # of days)	11.1	7.7	-3.4	(0.169)

[1] Change (+/-) was found to be statistically significant at the * p< .05, ** p<.01, or *** p< .001 level in a McNemars Test or Wilkoxon Signed Rank Test comparing pre-/post- intervention responses between paired samples (same respondent).

Table 33. General Health, Mental Health, and Sleep 2022

Survey Question/Paired Samples (n=17)	Pre-Intervention (n=17)	Post-Intervention (n=17)	Change (+/-)	(p-value) [1]
During the past 30 days, for about how many days do you feel you did not get enough rest or sleep? (mean # of days)	18.9	2.5	-16.4	***(<.001)
Thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good? (mean # of days)	13.2	4.1	-9.1	**(.006)
During the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation? (mean # of days)	13.2	7.9	-5.3	(0.111)

[1] Change (+/-) was found to be statistically significant at the * p< .05, ** p<.01, or *** p< .001 level in a McNemars Test or Wilkoxon Signed Rank Test comparing pre-/post- intervention responses between paired samples (same respondent).

Table 34. General Health, Mental Health, and Sleep 2023

Survey Question/Paired Samples (n=17)	Pre-Intervention (n=30)	Post-Intervention (n=30)	Change (+/-)	(p-value)[1]
During the past 30 days, for about how many days do you feel you did not get enough rest or sleep? (mean # of days)	19.4	4.5	-14.9	***(<.001)
Thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good? (mean # of days)	13.3	5.6	-7.7	**(.007)
During the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation? (mean # of days)	15.7	8.7	-7.0	*(.032)

[1] Change (+/-) was found to be statistically significant at the * p< .05, ** p<.01, or *** p< .001 level in a McNemars Test or Wilkoxon Signed Rank Test comparing pre-/post- intervention responses between paired samples (same respondent).

Table 35. General Health, Mental Health, and Sleep 2021, 2022, and 2023 Combined

Survey Question/Paired Samples (n=54)	Pre-Intervention (n=84)	Post-Intervention (n=84)	Change (+/-)	(p-value)[1]
During the past 30 days, for about how many days do you feel you did not get enough rest or sleep? (mean # of days)	16.3	6.6	-9.7	***(<.001)
Thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good? (mean # of days)	13.3	4.8	-8.5	***(<.001)
During the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation? (mean # of days)	13.0	8.0	-5.0	**(0.003)

[1] Change (+/-) was found to be statistically significant at the * p< .05, ** p<.01, or *** p< .001 level in a McNemars Test or Wilkoxon Signed Rank Test comparing pre-/post- intervention responses between paired samples (same respondent).

9. Energy Burden

A substantial and highly significant decrease in respondent worry about not having electricity and cooling was observed across the samples. A decrease by 70% was observed for the 2021, 2022, and 2023 cooling seasons combined. Statistically significant improvements in energy security (better able to afford energy bills) were also reported post-intervention for the combined samples. Not every cooling season sample reported it being no longer hard or very hard to pay changes, however the percentage of household that reported it being 'very hard' to pay bills decreased post-intervention. (
Table 36-31).

Table 36. Energy Burden 2021

Survey Question/Paired Samples (n=38)	Pre-Intervention (n=38)	Post-Intervention (n=38)	Change (+/-)	(p-value)[1]
Over the last 30 days, did you worry that your home would not have electricity or cooling?	76%	5%	-71%	***(<.001)
How hard is it to pay for your energy bills?				
Very easy or easy	0%	16%	16%	*(.031)
Neither hard nor easy	32%	50%	18%	*(.016)
Very hard or hard	68%	34%	-34%	***(<.001)
Very hard	32%	0%	-32%	***(<.001)

[1] Change (+/-) was found to be statistically significant at the * p< .05, ** p<.01, or *** p< .001 level in a McNemars Test or Wilkoxon Signed Rank Test comparing pre-/post- intervention responses between paired samples (same respondent).

Table 37. Energy Burden 2022

Survey Question/Paired Samples (n=18)	Pre-Intervention (n=18)	Post-Intervention (n=18)	Change (+/-)	(p-value)[1]
Over the last 30 days, did you worry that your home would not have electricity or cooling? (n=17)	82%	18%	-64%	***(<.001)
How hard is it to pay for your energy bills?				
Very easy or easy	0%	0%	-	No Change
Neither hard nor easy	22%	33%	11%	(.500)
Very hard or hard	78%	67%	-11%	(.500)
Very hard	44%	17%	-27%	(.125)

[1] Change (+/-) was found to be statistically significant at the * p< .05, ** p<.01, or *** p< .001 level in a McNemars Test or Wilkoxon Signed Rank Test comparing pre-/post- intervention responses between paired samples (same respondent).

Table 38. Energy Burden 2023

Survey Question/Paired Samples (n=34)	Pre-Intervention (n=34)	Post-Intervention (n=34)	Change (+/-)	(p-value)[1]
Over the last 30 days, did you worry that your home would not have electricity or cooling? (n=17)	86%	14%	-72%	***(<.001)
How hard is it to pay for your energy bills?				
Very easy or easy	6%	6%	-	No Change
Neither hard nor easy	27%	27%	-	No Change
Very hard or hard	78%	67%	-11%	(.500)
Very hard	32%	24%	-8%	(.549)

[1] Change (+/-) was found to be statistically significant at the * p< .05, ** p<.01, or *** p< .001 level in a McNemars Test or Wilkoxon Signed Rank Test comparing pre-/post- intervention responses between paired samples (same respondent).

Table 39. Energy Burden 2021 and 2022 Combined

Survey Question/Paired Samples (n=56)	Pre-Intervention (n=89)	Post-Intervention (n=89)	Change (+/-)	(p-value)[1]
Over the last 30 days, did you worry that your home would not have electricity or cooling? (n=54)	81%	11%	-70%	***(<.001)
How hard is it to pay for your energy bills?				
Very easy or easy	0%	11%	11%	*(.031)
Neither hard nor easy	29%	44%	15%	**(.004)
Very hard or hard	71%	45%	-26%	***(<.001)
Very hard	34%	12%	-22%	***(<.001)

[1] Change (+/-) was found to be statistically significant at the * p< .05, ** p<.01, or *** p< .001 level in a McNemars Test or Wilkoxon Signed Rank Test comparing pre-/post- intervention responses between paired samples (same respondent).

Observations

The combined results from the summers of 2021, 2022, and 2023 provide the basis for several important observations:

- Program recipients are older and spend a great deal of time in their homes.
- An overwhelming majority of program recipients report that their homes are comfortable post-intervention
- Substantial improvements in quality of life generally and with respect to sleep, and physical and mental health more specifically were observed within each cooling season and across samples.
- Being too hot in their homes appeared to negatively impact respondents' sleep with significant improvements in sleep; which can reduce stress, improve cognitive functioning, and improvement mental health.
- Respondents reported fewer medical instances of seeking urgent medical care for arthritis symptoms, respiratory care, and heat-related symptoms post-intervention. Reductions in medical encounters, though small in number, can save healthcare thousands of dollars and reduce trauma caused by emergency department and hospital visits; and can, in extreme cases, save lives.
- Respondents self-reported that heat worsens their or other household members symptoms associated with asthma, COPD, and arthritis. More comfortable homes help to alleviate the impact of these diseases on occupants and can – in some cases – lead to reduced needs for medical interventions and reduced healthcare costs.
- The installation of more efficient and functional HVAC systems reduced self-reported energy burdens. Improvements in energy security and burden can lead to other direct and indirect household and health benefits.

Conclusion

In conclusion, findings from the impact survey indicate that the health and household-related non-energy impacts of a Healthy Homes Pilot Program delivered in Maricopa County provides substantial, and in many cases, statistically significant outcomes for the recipients of the pilot program. Improvements in comfort and safety, as well as reduced medical encounters, were observed. These impacts suggest improvements in the physical and mental health of recipients, reductions in energy burden, and potential societal benefits through reductions in the utilization of medical encounters. Significant impacts are observed in every cooling season.