



VOLUME 1,
ISSUE 2

INSIGHTS: Data Brief

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WILDFIRE SMOKE IMPACTS IN WESTERN STATES AND GAPS IN HOUSEHOLD PREPAREDNESS



Heluna Health®



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KEY TAKEAWAYS

- Nearly half of adults living in Western states experienced wildfire smoke during the past three years.
- More than one in four adults who were exposed to wildfire smoke over the past three years said they were highly impacted by the smoke. Specific domains where people reported being most highly impacted included outdoor air quality (52% of adults), exercise and physical activity (31% of adults), and mood and mental well-being (25% of adults). One in five adults said their indoor air quality was highly impacted by the wildfire smoke.
- Among adults who experienced wildfire smoke during the past three years, approximately one in five missed work due to the smoke. Those who missed work were more likely to be male, younger (age <50 years), or of Hispanic ethnicity.
- Eight percent of adults in Western states have a job that requires them to primarily work outside (≥ 4 hours per day). Sixty-five percent of those workers reported that their employers provide a high-quality mask or alternative working location or time, if needed, to reduce wildfire smoke exposure. Thirty-five percent of those workers did not report receiving such provisions.
- More than one in ten adults reported having low knowledge regarding where to find information about recommended actions to take during a wildfire. These adults were more likely to be younger (age 18-29), identify as being Black/African American, or have an annual household income below \$55,000.
- Adults younger than 50 years old or with household incomes less than \$35,000 per year were less able to make home modifications when compared to adults ages 65 years or older or adults with household incomes \$55,000 per year or higher, respectively. Home modifications that help reduce outdoor smoke exposures include sealing cracks and gaps in doors and windows or installing an air conditioning system.
- Approximately one in five adults said they would be highly likely to visit an indoor clean air shelter during the day or night to avoid wildfire smoke exposures.
- One in five adults in Western states said their households would be unprepared for wildfire smoke if it were to occur. Adults who were ages 18-29 (30%), Black/African American (35%), or with household incomes <\$35,000 per year (29%) were the most likely to say their households were unprepared.

INTRODUCTION

Wildfires are a common occurrence in summer months. The United States Environmental Protection Agency (EPA) has documented an average of 70,000 wildfires occurring nationally per year since 1983.(1) Though this frequency of wildfires has remained fairly constant over the past four decades, the extent and severity of wildfires have been increasing, in large part due to human-caused climate change.(1-3) In 2020, wildfires caused damage to approximately 10 million acres of land nationwide.(1) Tracking of wildfires over the past four decades has shown that the majority of damage has occurred in Western states.

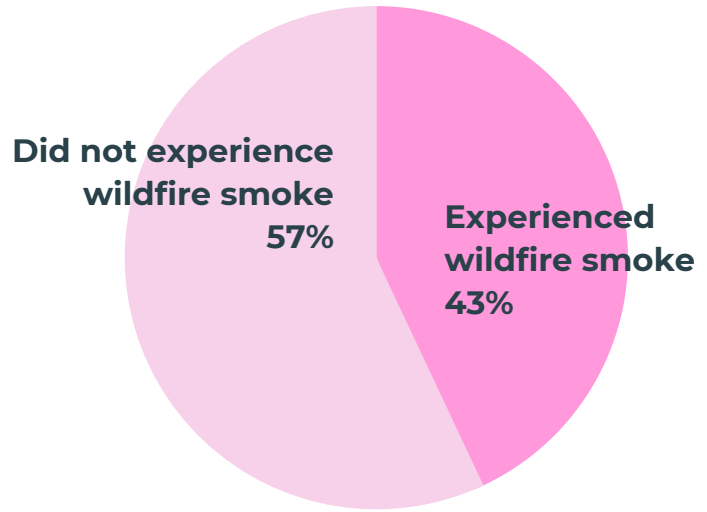
Wildfire smoke is a far-reaching effect of wildfires. Smoke plumes can spread across very long distances (such as into neighboring states), with the potential to impact large portions of the population, affecting quality of life and causing adverse health effects. Wildfire smoke presents a significant public health challenge, as it worsens air quality, which has been linked to increases in respiratory-related emergency department visits, hospital admissions, and death. (1, 2, 4, 5) Both indoor and outdoor air quality impacts have been noted, affecting well-being in both proximally located populations and those located relatively far from the actual wildfire. (6) In an effort to mitigate these impacts, many local and federal agencies have developed guidelines to help households prepare for wildfire smoke. (6-8) These guidelines include recommendations such as making modifications to the home environment (e.g. sealing gaps in doors and windows and installing high quality air filters), using high quality masks, and knowing how to check air quality and when to stay indoors. Currently, the percentage of the population adhering to these guidelines is unknown, as is an understanding of the limitations in knowledge or capabilities U.S. households may be facing in their ability to adhere to those guidelines.

We conducted a representative panel survey of 1,780 adults living in Western states to assess the impacts of wildfire smoke and levels of household preparedness. In particular, we examined areas of knowledge and capabilities for preparedness in accordance with existing guidelines, to identify gaps and opportunities for interventions. These findings can inform future work by local organizations and government agencies to improve household preparedness among high-risk populations.

WILDFIRE SMOKE EXPOSURE

Nearly half (43%) of adults (≥18 years) living in Western states experienced wildfire smoke in the past three years (Figure 1). Of those who reported experiencing wildfire smoke, one in seven people experienced wildfire smoke totaling more than one month (Figure 2).

Figure 1. % of adults living in Western states who experienced wildfire smoke between 2020-2023



NOTE: Estimates include the percentage of the adult population in Western states who experienced wildfire smoke at home or at work between January 2020 and May 2023.

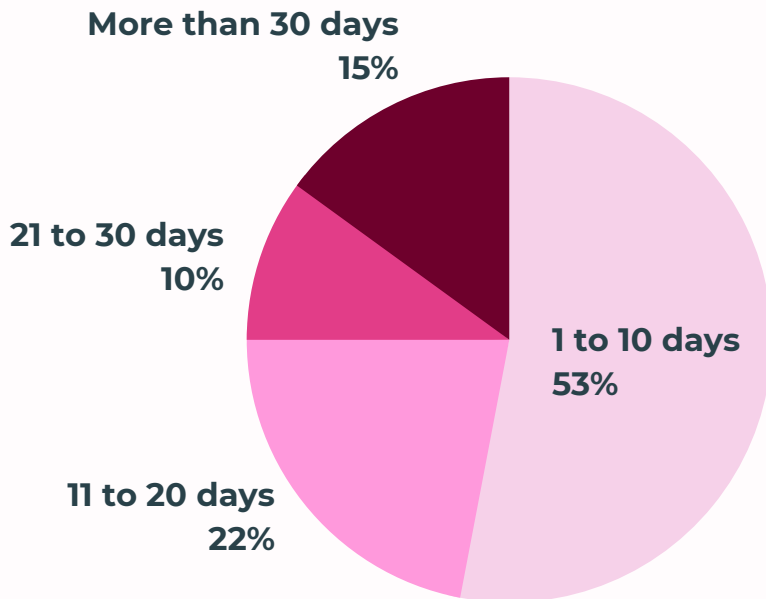


Figure 2. Total # of days of smoke exposure, among adults who experienced wildfire smoke between 2020-2023

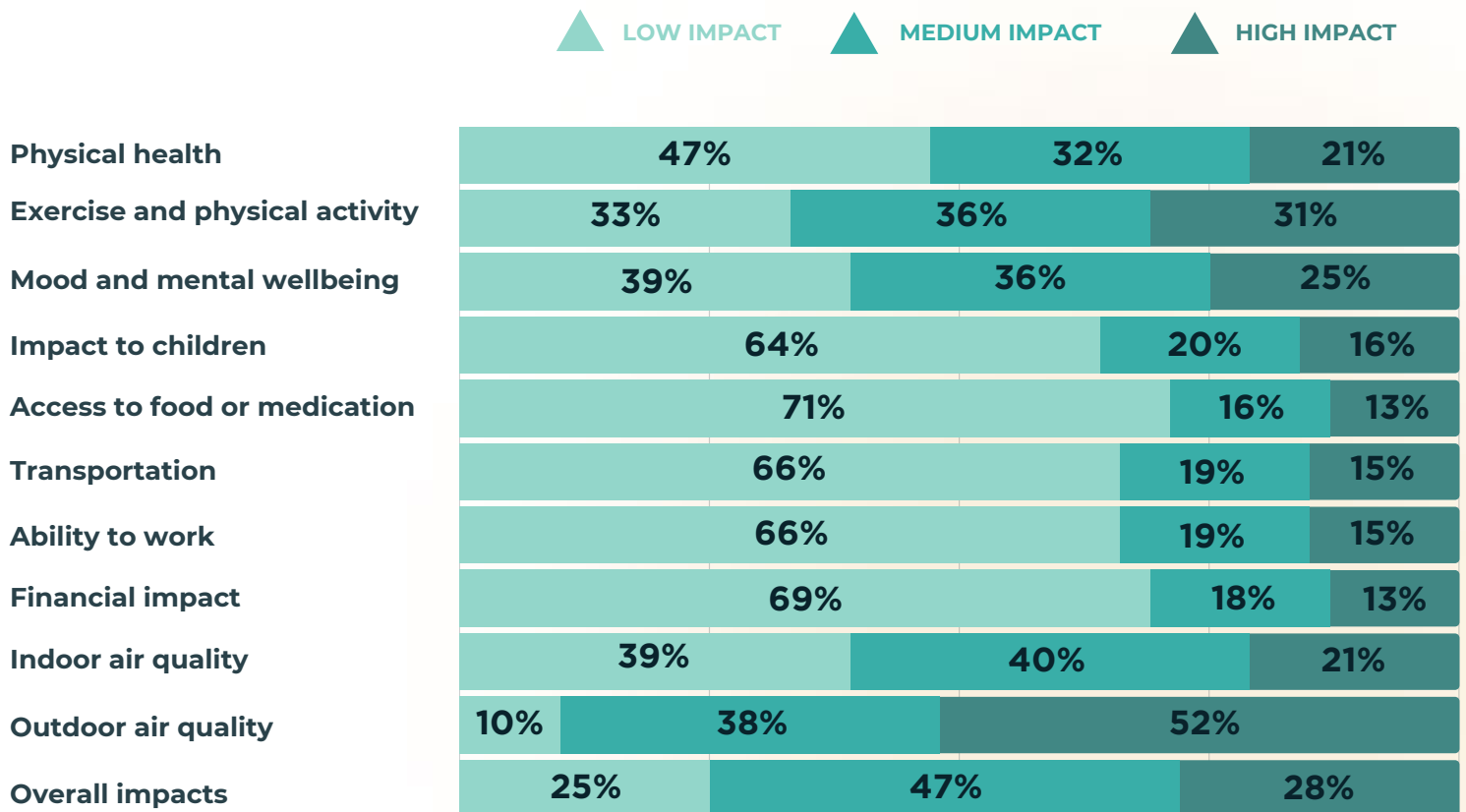
NOTE: Estimates include the total number of days in which adults in Western states experienced wildfire smoke between January 2020 and May 2023, among those who experienced wildfire smoke during that time period.



WILDFIRE SMOKE IMPACTS

Among adults that were exposed to wildfire smoke during the past three years, at least one in ten adults reported being highly impacted within each of the areas assessed (Figure 3). The largest number of respondents reported being highly impacted with respect to outdoor air quality (52% highly impacted), exercise and physical activity (31% highly impacted), and mood and mental well-being (25% highly impacted). One in five adults reported that their indoor air quality was also highly impacted by the wildfire smoke.

Figure 3. Reported impacts of wildfire smoke among adults living in Western states who experienced wildfire smoke between 2020-2023



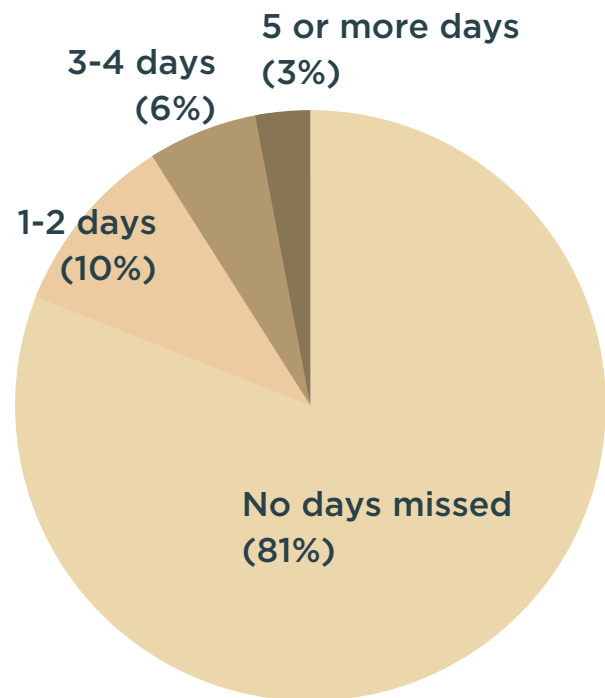
NOTE: Estimates shown are for adults who were exposed to wildfire smoke between January 2020 and May 2023. Categories of impact were based on responses to 10-point Likert scale survey questions as follows: 1-3 (low impact), 4-7 (moderate impact), 8-10 (high impact).

WILDFIRE SMOKE & MISSED WORK

Among adults who experienced wildfire smoke at home or at work during the past three years, approximately one in five people missed at least one day of work due to that smoke (Figure 4). Three percent of adults missed a full work week or more within that time frame, due to wildfire smoke.

The likelihood of missing work due to wildfire smoke differed significantly by sex, age, and ethnicity, but not by race or household income (Figure 5). Males were nearly twice as likely to miss work compared to females (24% vs 13%). Younger adults (below the age of 50) were more likely to report missing work (approximately one-third of each age group between 18 and 49), compared to adults ages 50 and older (<10%). Over one in four Hispanic adults missed work due to wildfire smoke, compared to about one in seven non-Hispanic adults.

Figure 4. % of adults living in Western states that missed work due to wildfire smoke between 2020-2023, among those who were exposed to wildfire smoke

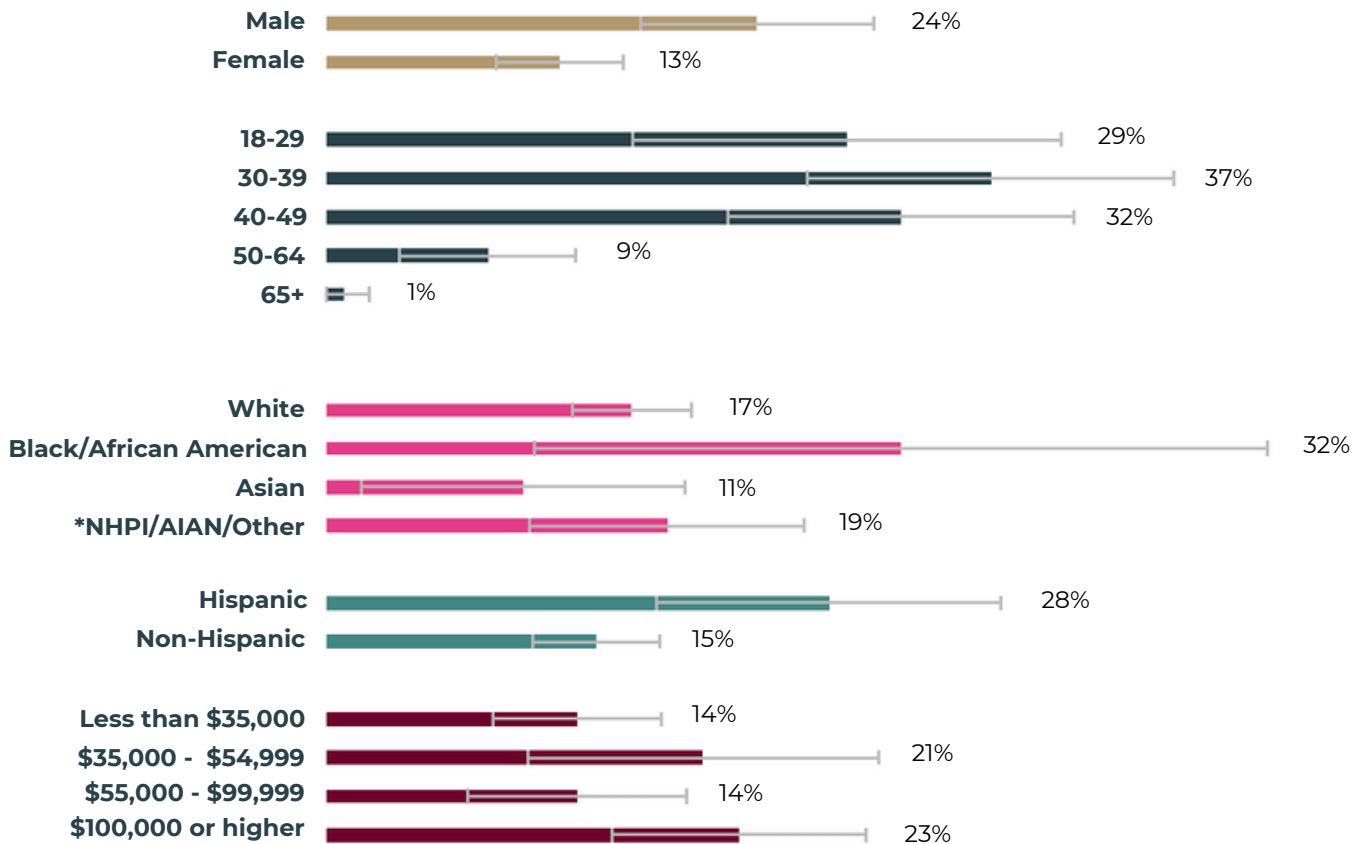


NOTE: Estimates represent percentages of adults who missed work due to wildfire smoke between January 2020 and May 2023, among those who experienced wildfire smoke at home or at work during that time period.



WILDFIRE SMOKE & MISSED WORK

Figure 5. % of adults living in Western states by demographic characteristics who missed at least one day of work due to wildfire smoke between 2020-2023, among adults who experienced wildfire smoke



NOTE: Percentages include adults who reported missing at least 1 day of work due to wildfire smoke between January 2020 and May 2023, among those who experienced wildfire smoke at home or at work. Gray lines at ends of bars represent 95% confidence intervals for percentages (non-overlapping confidence intervals indicate significant differences between groups). *NHPI = Native Hawaiian or Other Pacific Islander. AIAN = American Indian or Alaska Native. Other races can include respondents who reported multiple races. Due to small numbers of respondents within each of these race categories, we were unable to draw conclusions for these individual groups, and we combined categories for analysis.

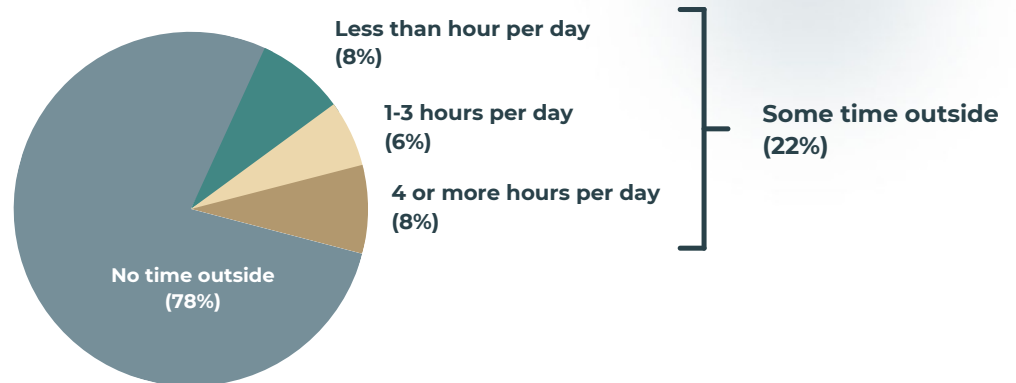


WILDFIRE SMOKE & WORK CONDITIONS

More than one in five adults reported having a job that requires them to work outside during at least part of the day (Figure 6). Approximately one in twelve adults reported having a job that requires them to primarily work outside (4 or more hours each day).

Among adults whose job requires them to work outside, 53%-65% said their employer provides a high-quality mask (N95 or similar) or an alternative working location or alternative working schedule if needed due to wildfire smoke (Figure 7). A greater share of adults were provided a mask per report, compared to being provided an alternative working location or schedule, particularly among adults who were required to work outside four or more hours per day. The likelihood of an employer providing a mask or alternate working environment varied by the length of time employees are required to work outside, but these differences did not reach statistical significance.

Figure 6. % of adults living in Western states who have a job requiring them to work outside



NOTE: Percentages were calculated for the entire adult population, regardless of current working status.

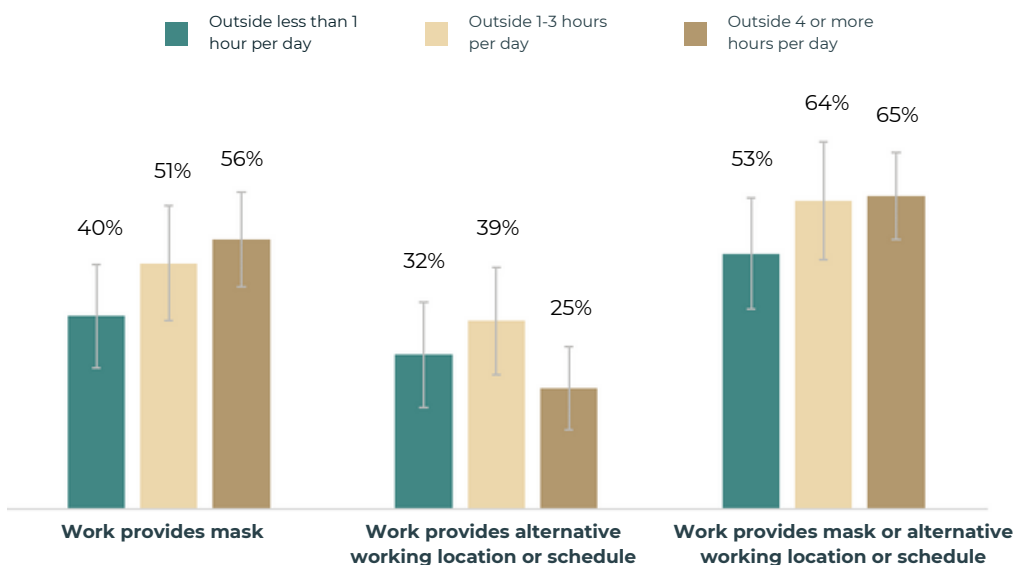


Figure 7. % of adult population required to work outdoors whose employer provides a high-quality mask or an alternative working location or schedule during wildfire smoke events, among adults living in Western states

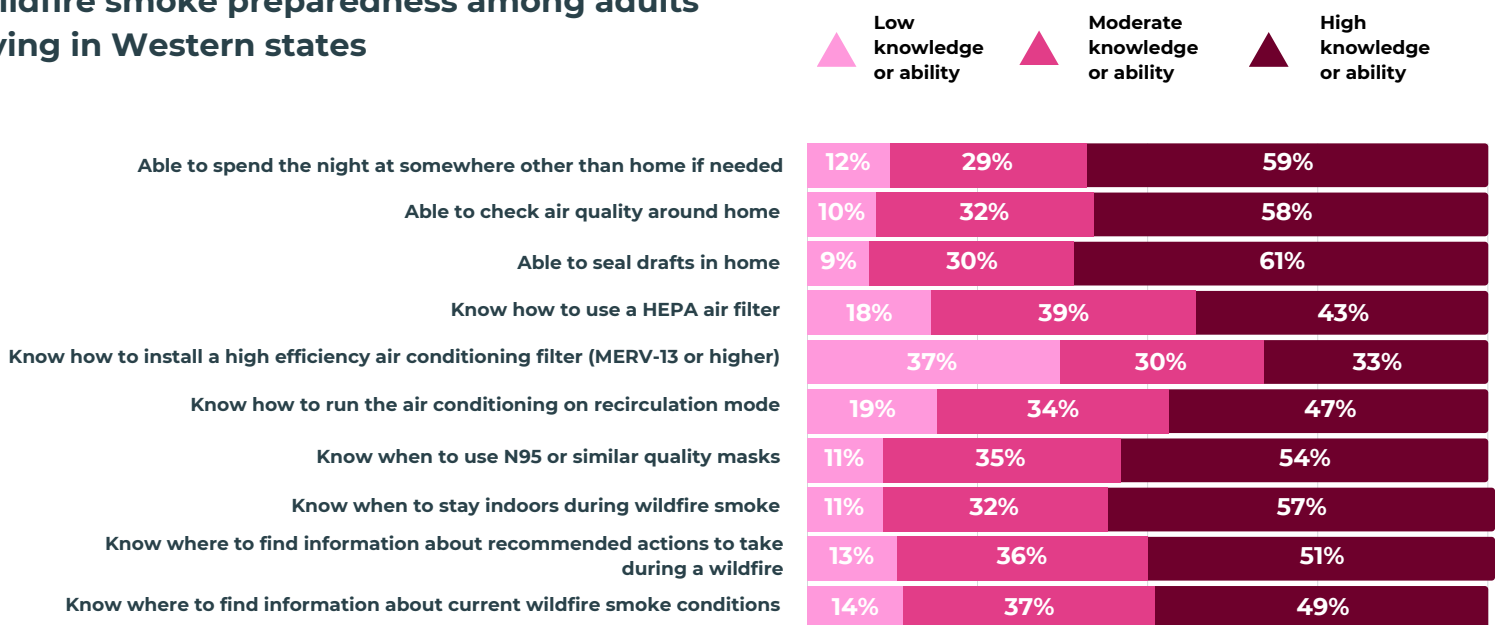
NOTE: Estimates represent percentages of adults whose employers provide a high-quality mask (N95 or higher) or alternative working location, among adults whose job requires them to work outside. Gray lines at ends of bars represent 95% confidence intervals for percentages (non-overlapping confidence intervals indicate significant differences between groups).

KNOWLEDGE & PREPAREDNESS RELATED TO WILDFIRE SMOKE

For each aspect of wildfire smoke preparedness assessed, approximately one in 10 adults or more reported having low knowledge or capabilities in how to prepare for the effects of wildfire smoke (Figure 8). About half of respondents reported that they had high knowledge regarding where to find information about wildfire smoke conditions and what recommended actions to take during wildfires. Preparedness actions with the lowest levels of knowledge were how to install a high efficiency air conditioner (MERV-13 or higher); how to run the air conditioning on recirculation mode; and how to use a HEPA air filter (37%, 19%, and 18% of adults reported low knowledge in these areas, respectively). Preparedness actions where adults reported the highest capabilities were in the ability to seal drafts in their home (i.e. gaps around doors and windows); spend the night elsewhere if needed; and check air quality (61%, 59%, and 58% of adults reported high capabilities in these areas, respectively).

Knowing where to find information about recommended actions to take during a wildfire differed significantly by age, race, and household income (Figure 9). Younger adults (ages 18-29 years) were less knowledgeable (21% reported low knowledge) compared to adults ages 40 years and older (≤11% reported low knowledge). Nearly one-third of Black/African American adults (27%) reported having low knowledge regarding where to find information, compared to 10% of White respondents. Households with annual incomes less than \$55,000 were at least twice as likely to report having low knowledge about where to find information about recommended preparedness actions, compared to households with incomes \$55,000 or higher.

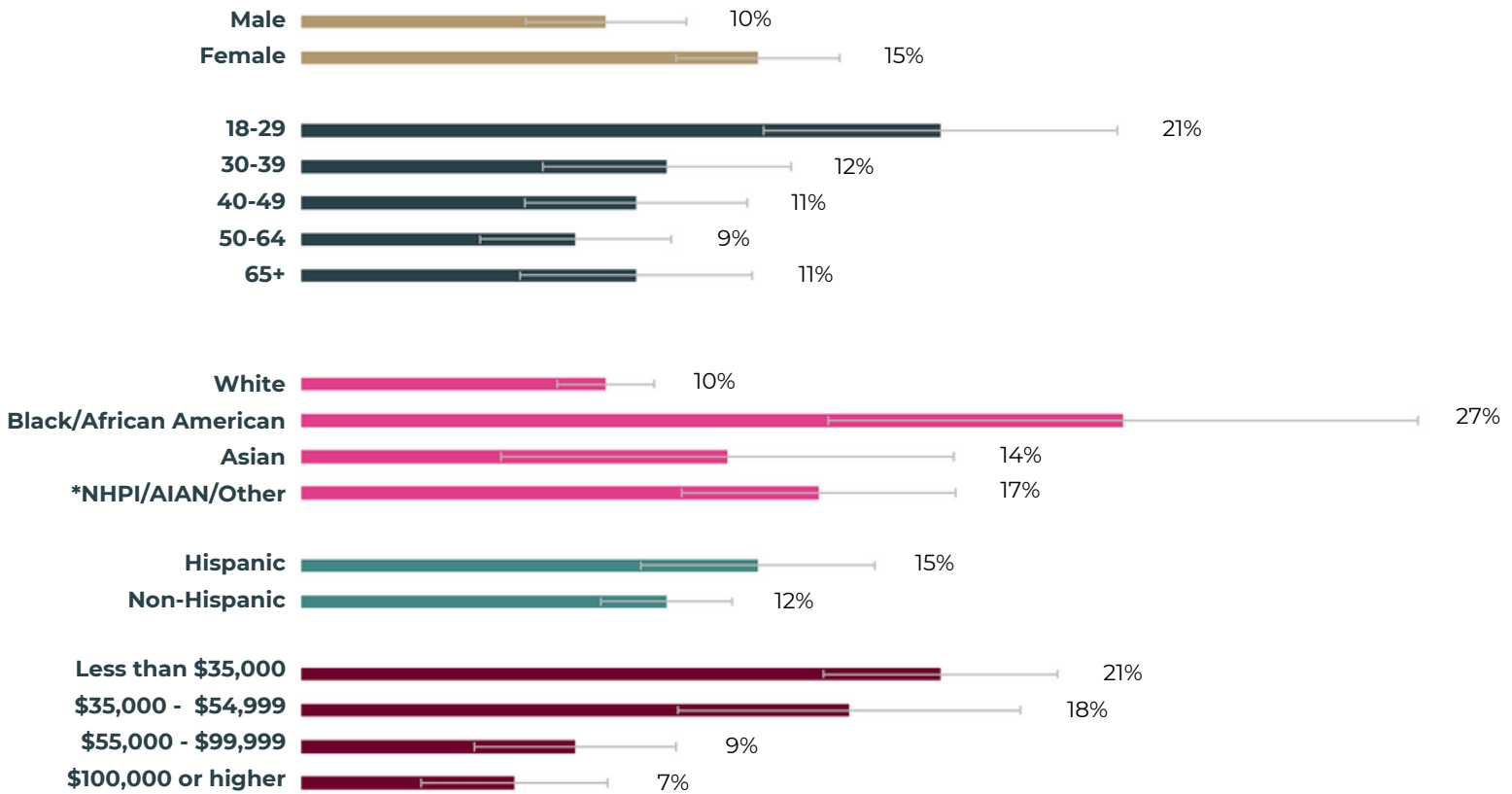
Figure 8. Knowledge and capabilities related to wildfire smoke preparedness among adults living in Western states



NOTE: Estimates represent the percentage of adults who indicated they had low, moderate, or high knowledge or capabilities in each of the areas shown. Categories were based on responses to 10-point Likert scale survey questions assessing knowledge and capabilities as follows: 1-3 (low), 4-7 (moderate), 8-10 (high). 1-3 (low), 4-7 (moderate), 8-10 (high).

KNOWLEDGE & PREPAREDNESS RELATED TO WILDFIRE SMOKE

Figure 9. % of adults living in Western states by demographic characteristics who reported having low knowledge regarding where to find information about recommended actions to take during a wildfire

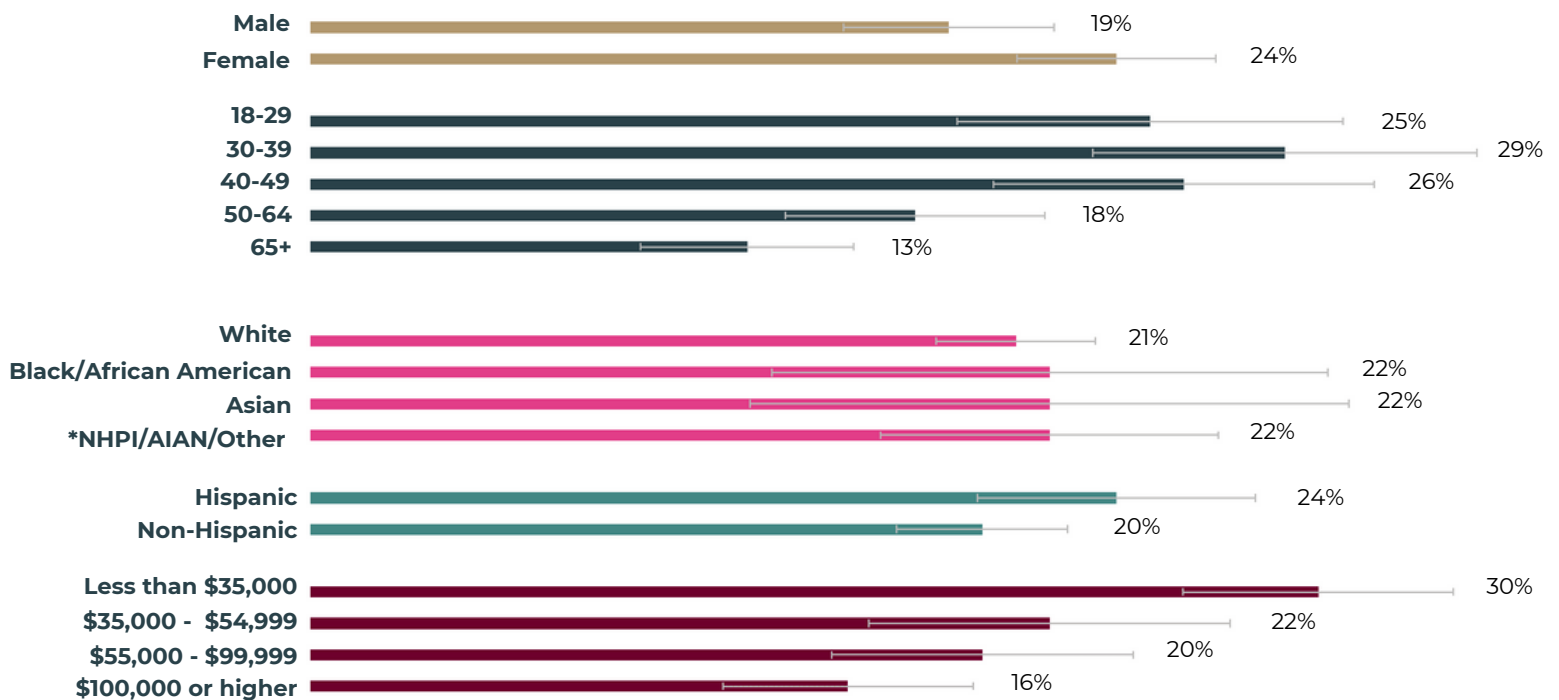


NOTE: Estimates were based on responses of 1-3 on a 10-point Likert scale assessing knowledge regarding where to find information about recommended actions to take during a wildfire (where 1 represented “no confidence” and 10 represented “extremely confident” in one’s knowledge). Gray lines at ends of bars represent 95% confidence intervals for percentages (non-overlapping confidence intervals indicate significant differences between groups). *NHPI = Native Hawaiian or Other Pacific Islander. AIAN = American Indian or Alaska Native. Other races can include respondents who reported multiple races. Due to small numbers of respondents within each of these race categories, we were unable to draw conclusions for these individual groups, and we combined categories for analysis.

BARRIERS TO HOME MODIFICATIONS

Western residents reported significant differences in their ability to make modifications to their home environment based on age and income (Figure 10). Modifications were defined as actions that would reduce drafts in the home and the installation of air filters or air conditioning. People in younger age groups (<50 years old) were more likely to experience barriers to making home modifications, with more than one in four adults in this age group reporting high barriers. In contrast, fewer adults 65 years of age or older (one in eight) reported experiencing high barriers to making home modifications. Perhaps not surprisingly, adults with household incomes less than \$35,000 per year were much more likely to experience high barriers to making home modifications (30% with high barriers) compared to adults with household incomes \$55,000 per year or higher (≤20% with high barriers).

Figure 10. % of adults living in Western states who reported having high barriers to making home modifications that addressed wildfire smoke preparedness



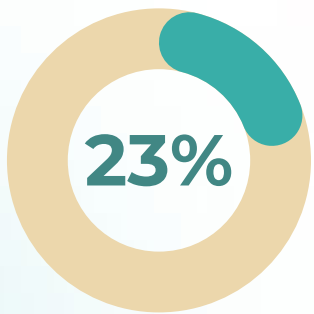
NOTE: Estimates were based on responses of 8-10 on a 10-point Likert scale assessing barriers to making home modifications that addressed wildfire smoke preparedness, including preventing drafts and installing air filters or air conditioning (1 represented "no barriers" and 10 represented "high barriers"). Gray lines at ends of bars represent 95% confidence intervals for percentages (non-overlapping confidence intervals indicate significant differences between groups). *NHPI = Native Hawaiian or Other Pacific Islander. AIAN = American Indian or Alaska Native. Other races can include respondents who reported multiple races. Due to small numbers of respondents within each of these race categories, we were unable to draw conclusions for these individual groups, and we combined categories for analysis.

SEEKING SHELTER FROM WILDFIRE SMOKE

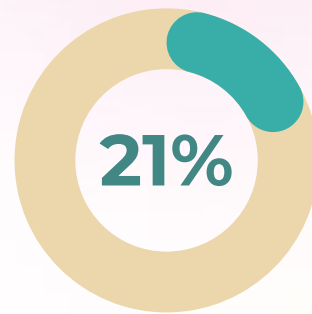
About one in five adults said they would be highly likely to visit a clean air shelter during the day or spend the night at a clean air shelter to avoid wildfire smoke (Figure 11). Similar percentages of adults indicated they would be highly likely to visit a clean air shelter during the day (23%) or night (21%), suggesting that time of day was not a significant factor when seeking shelter.

Figure 11. % of adults living in Western states who said they would be highly likely to spend the day or night at a clean air shelter to avoid wildfire smoke

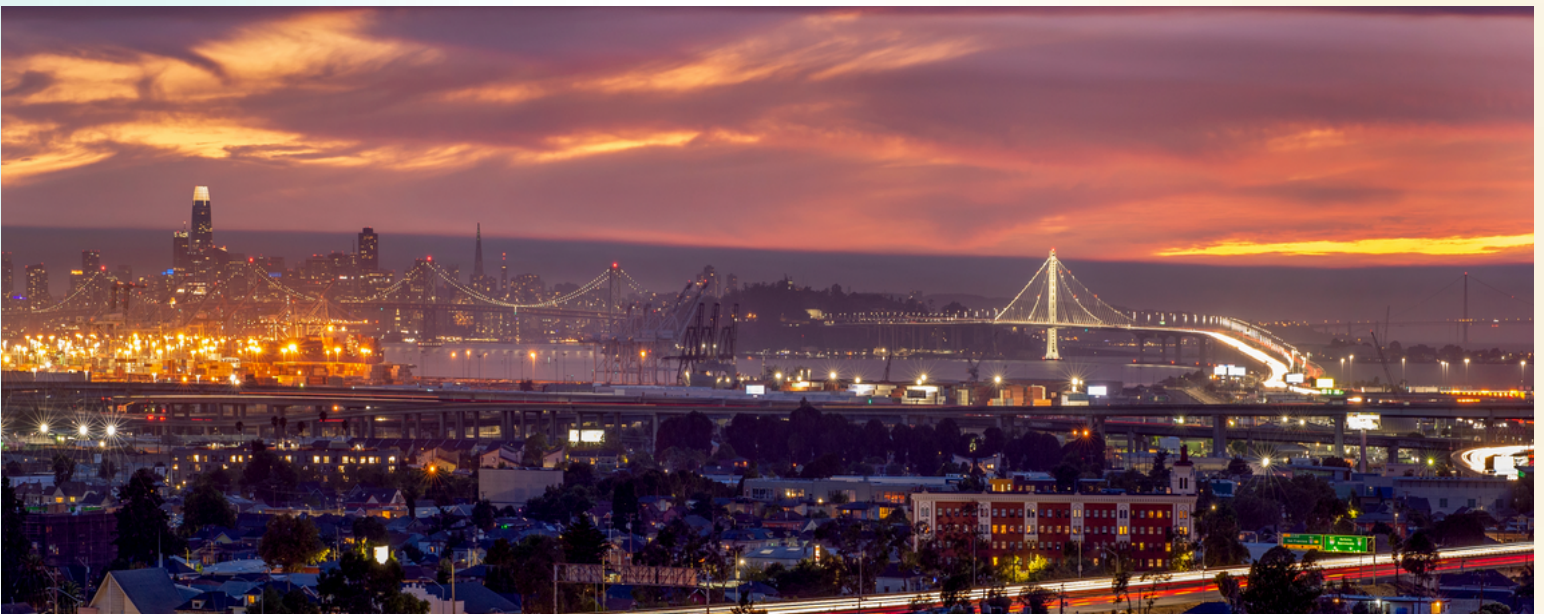
Highly likely to visit an air shelter during the day



Highly likely to spend the night at an air shelter



NOTE: Estimates represent the percentage of adults who responded 8-10 on 10-point Likert scale questions assessing the likelihood of using an air shelter during the day or at night (1 represented "very unlikely" and 10 represented "very likely").

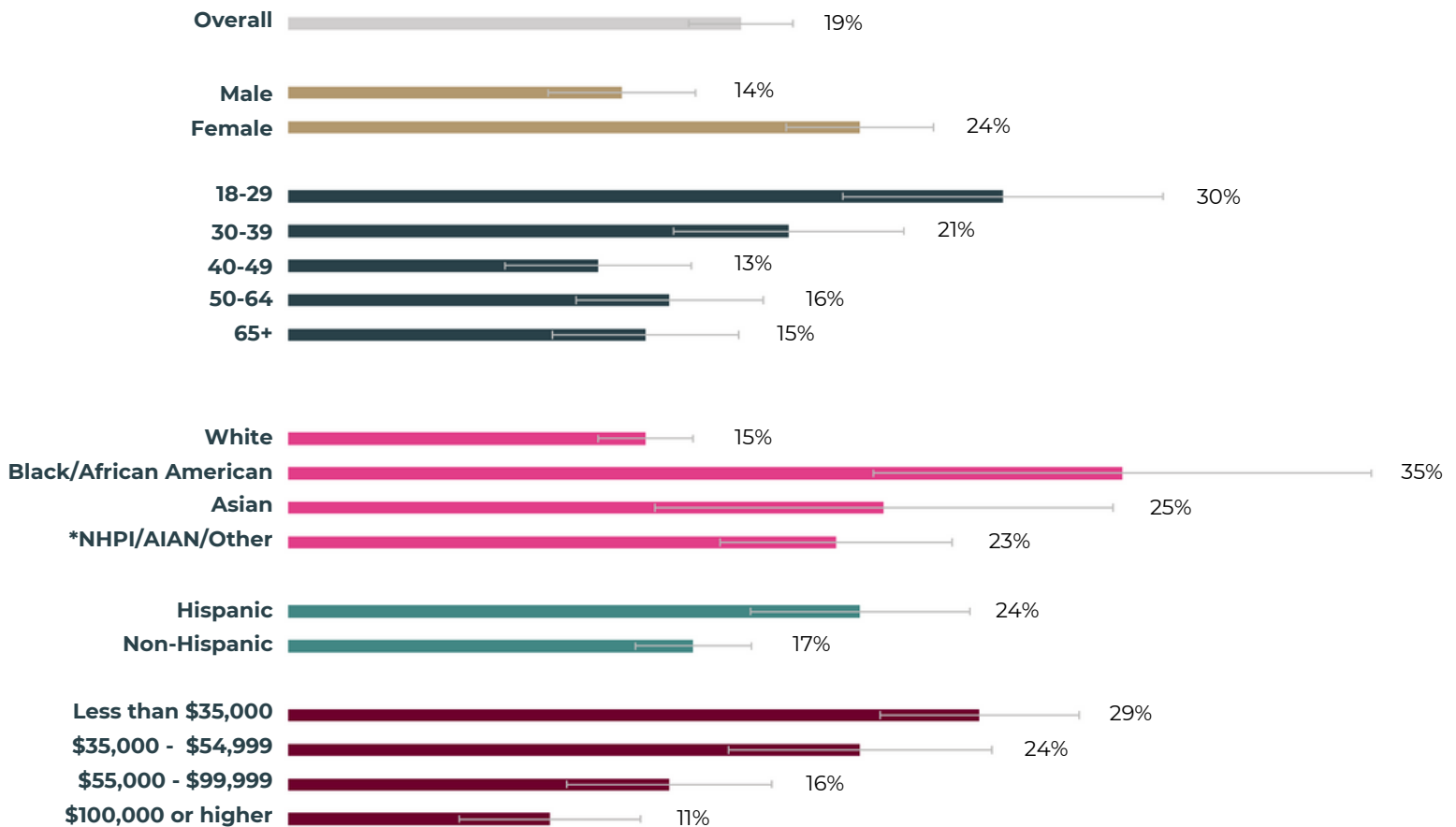


ARE WESTERN RESIDENTS READY?

Overall, nearly one in five adults living in Western states said their household would be unprepared if a wildfire happened now (Figure 12). Statistically significant differences in household preparedness exist by sex, age, race, ethnicity, and household income.

Adult females were much more likely to say their household would be unprepared (24%) when compared to adult males (14%). Adults aged 18-29 years were the least likely to feel prepared, when compared to older age groups. Nearly one in three adults aged 18-29 (30%) said their household would be unprepared, compared to ≤16% of adults ages 40 years or older. Black/African American and Hispanic populations were more likely to say their households would be unprepared for wildfire smoke (35% and 24%, respectively) when compared to White and non-Hispanic populations (15% and 17%, respectively). The likelihood of being unprepared increased with decreasing household income. Nearly one-third of adults with household incomes <\$35,000 per year said their household would be unprepared for wildfire smoke, compared to approximately ten percent of adults with household incomes \$100,000 per year or higher.

Figure 12. % of adults living in Western states who said their household would be unprepared if wildfire smoke were to occur



NOTE: Estimates represent the percentages of adults who responded 1-3 on a 10-point Likert scale question assessing one's perception of household preparedness for wildfire smoke if it were to occur now (1 represented "very unprepared" and 10 represented "very prepared"). Gray lines at ends of bars represent 95% confidence intervals for percentages (non-overlapping confidence intervals indicate significant differences between groups). *NHPI = Native Hawaiian or Other Pacific Islander. AIAN = American Indian or Alaska Native. Other races can include respondents who reported multiple races. Due to small numbers of respondents within each of these race categories, we were unable to draw conclusions for these individual groups, and we combined categories for analysis.

CONCLUSION



Nearly half of adults living in the Western United States have been impacted by wildfire smoke in the past three years. At the same time, approximately half of all adults do not have high levels of awareness regarding key actions to take to protect themselves from the smoke. Importantly, over ten percent of the adult population indicated that they do not know where to find information about recommended actions to take during a wildfire. The impacts of wildfire smoke span across multiple domains related to health and quality of life, including mental well-being, physical health, and missed work. These findings underscore the need for enhanced outreach, particularly in Western states, regarding household preparations that help to reduce the health-related impacts of wildfire smoke exposures.

Overall, one-fifth of adults in the Western United States reported that their household would be unprepared if a wildfire were to occur. Based on recent population estimates (9), this finding represents approximately five million households located in Western states that are unprepared. We observed significant disparities in household preparedness by sex, age, race, ethnicity, and household income. Adults who were younger or from low-income households indicated they were less knowledgeable about what actions they should take during a wildfire and were less able to make modifications to their home environment to mitigate the impacts of wildfire smoke, compared to adults who were older or who had higher household incomes. Overall, the demographic groups with the lowest degree of wildfire smoke preparedness were females, younger adults, low-income households, and Black/African American and Hispanic adults. Only about two-thirds of adults who primarily work outdoors reported that their employers had some kind of accommodation to mitigate the impacts of smoke exposure.

The findings from this survey suggest the need for improved preparedness for wildfire smoke, especially among demographic groups where we observed disparities. These findings also present opportunities for public health agencies and other local leaders to prioritize specific populations for enhanced education regarding household preparedness in future efforts surrounding wildfire smoke. Additionally, promotion of clean air shelters could improve their use and provide refuge from smoke, particularly for populations who are unable to make necessary modifications to their home environment. Efforts may also include changes to workplace policies to improve the accessibility of high quality masks or alternative work environments on days with wildfire smoke, to decrease missed work days or otherwise mitigate the health impacts of wildfire smoke. Such interventions can help address the disparate impacts of wildfire smoke, improving population-wide preparedness and protecting public health.



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DEFINITIONS

Race: We categorized survey responses for race as White alone, Black or African American alone, Asian alone, or NHPI/AIAN/Other Races. This latter group included adults who identified as Native Hawaiian or Pacific Islander race, American Indian or Alaskan Native, two or more races, or a different race; due to small numbers of respondents within each of these race categories, we were unable to draw conclusions for these individual groups, and we combined these categories for analysis.

Ethnicity: Hispanic respondents included those who self-identified as being of Hispanic, Latino, or of Spanish origin. Hispanic and non-Hispanic categories could include any race.

Data Sources and Methods: In May 2023, Heluna Health conducted a representative panel survey of adults living in the Western region of the United States (EPA regions 8, 9, and 10), a geographic region at high risk for wildfires. States in which surveys were conducted included Alaska, Arizona, California, Colorado, Idaho, Montana, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming. We collected a total of 1,780 surveys, to which post-stratification weights were applied so that sample demographics would match the distribution of the Western state population. Weights were based on population characteristics collected for age group, sex, race, Hispanic ethnicity, household income, rural zip code status, and western region. These population characteristics were drawn from the 2021 American Community Survey 1-year estimates, except for household income, which was drawn from the Census Bureau's 2022 Annual Social and Economic Supplement from the Current Population Survey.

For survey questions that were asked on a 1-10 point Likert scale, we categorized responses for analysis as follows: 1-3 (low), 4-7 (moderate), and 8-10 (high). We compared percentages of respondents within "low" and "high" categories by demographic characteristics including sex, age, race, ethnicity, and income. We constructed 95% confidence intervals, which were used to identify significant differences in estimates across demographic groups.

Acknowledgements: We would like to acknowledge the Altarum Institute, which collaborated with Heluna Health on the design of the survey and data collection. We also thank panel survey participants.

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Actions to Prepare for Wildfire Smoke and to Protect Your Health During Wildfires

Preparing for a Wildfire Smoke Event

1. **Prepare supplies in your home.** During smoky conditions, limit how often you need to go in and out of your home. Have these supplies available in your home:
 - a. A high-efficiency air purifier or filter for your air conditioning system with MERV 13+ or HEPA rating.
 - b. A high-quality N95 mask to use if you need to go outside in smoky conditions.
 - c. Prescription medication (at least 1 week's supply).
 - d. Food and water. It is especially helpful to have some foods that do not require cooking.
2. **Seal cracks or gaps in your home to help keep smoke out.** Install weather stripping or use caulking to help reduce gaps around doorways or windows.
3. **Medical action plans if you have asthma, other lung diseases, or heart diseases.** Talk to your medical provider about developing a medical action plan for your health conditions. People with lung or heart diseases are more likely to experience health problems, such as breathing problems, due to wildfire smoke.
4. **Install a carbon monoxide detector inside your home, especially if you plan to use a generator.** Ensure your generator is installed outdoors at least 20 feet away from your home, so that gases from the generator do not concentrate inside your home.

During a Wildfire Smoke Event

1. **Check your local air quality** – www.airnow.gov or the AirNow smartphone app or check with your local air pollution agency.
2. **Stay indoors when air quality is unhealthy.** Staying indoors will help protect you from the smoke outdoors. If you must go outdoors, wear a well-fitted N95 mask.
3. **Filter the indoor air.** Use a high-efficiency filter (with a MERV 13+ or HEPA rating) in your air conditioning system or in a stand-alone air purifier.
4. **Avoid outdoor physical activities.** Avoiding outdoor physical exertion will help limit how much smoke you breathe in.
5. **Don't worsen indoor air pollution.** Avoid frying or grilling foods. Instead, steaming or boiling food creates less indoor air pollution. Avoid burning firewood or other wood-burning appliances.
6. **Seek medical care if needed.** If you or your family member has trouble breathing, or if you experience a worsening in your health condition, contact your healthcare provider or call 911.

Additional Resources

- Health effects of wildfire smoke: <https://www.cdc.gov/disasters/wildfires/smoke.html>
- Understanding the Air Quality Index: <https://www.airnow.gov/aqi/aqi-basics/>
- Information about using masks during wildfire smoke events: <https://wspshsu.ucsf.edu/wp-content/uploads/2020/08/mask-or-respirator-use-by-children-and-pregnant-women-during-wildfire-smoke-events.pdf>
- Cleaning up after a wildfire: <https://www.redcross.org/get-help/how-to-prepare-for-emergencies/types-of-emergencies/fire/cleaning-up-after-fire.html>