# Assessing Shifts in Health Disparities: Analyzing the Impact of the COVID-19 Pandemic in Washington State, 2018-2023

Faiza Awale

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Committee:

Grace C. John-Stewart

Danny Colombara

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## Abstract

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Faiza Awale

Chair of the Supervisory Committee:

Grace C. John-Stewart

Department of Epidemiology

*Background:* The COVID-19 pandemic intensified longstanding health inequities in the United States, particularly among historically marginalized racial and ethnic groups. In Washington State, American Indian/Alaska Native (AIAN), Native Hawaiian/Pacific Islander (NHPI), Black, and Hispanic populations face disproportionate burdens due to structural determinants such as socioeconomic disadvantage, limited healthcare access, and systemic racism. However, limited research has examined how these disparities evolved across different phases of the pandemic at the state level.

*Methods:* This retrospective observational study analyzed data from the Washington State Behavioral Risk Factor Surveillance System (BRFSS), spanning 2018–2023 ($n$ = 100,791 after applying exclusion criteria). Key outcomes included frequent poor mental health (defined as ≥14 days of poor mental health

in the past 30 days), chronic disease (a composite indicator of any of the following self-reported, physician-diagnosed conditions: asthma (current), diabetes, arthritis, chronic obstructive pulmonary disease (COPD), kidney disease, stroke, myocardial infarction, and angina or coronary heart disease (CHD)), and healthcare access (defined as being unable to see a doctor due to cost). Survey-weighted logistic and Poisson regression models estimated adjusted prevalence differences (PDs) and prevalence ratios (PRs) across three pandemic periods—pre-pandemic (2018–2019), during-pandemic (2020–2021), and post-pandemic (2022–2023)—by race/ethnicity, adjusting for age, sex, education, and employment.

*Results:* Racial and ethnic disparities in mental health, chronic disease, and healthcare access (i.e., being unable to see a doctor due to cost) widened during and after the COVID-19 pandemic in Washington State. Asian and Hispanic adults consistently reported lower adjusted prevalence and prevalence ratios (PRs) of frequent poor mental health compared to White adults, including during the post-pandemic period (Asian: PR = 0.72; 95% Confidence Interval (CI): 0.55–0.94; Hispanic: PR = 0.68; 95% CI: 0.55–0.83). In contrast, American Indian/Alaska Native (AIAN) and Native Hawaiian/Pacific Islander (NHPI) adults experienced the highest burden of chronic disease post-pandemic, with adjusted prevalence exceeding that of White adults by 15.3 and 16.7 percentage points, respectively. PRs for chronic disease remained significantly elevated for both groups (AIAN: 1.34; 95% CI: 1.11–1.62; NHPI: 1.44; 95% CI: 1.08–1.91). Cost-related barriers to care were disproportionately high among AIAN, NHPI, and Hispanic adults. Post-pandemic PRs were 1.86 (95% CI: 1.13–3.06) for AIAN adults, 1.71 (95% CI: 1.40–2.07) for Hispanic adults, and 1.93 (95% CI: 1.12–3.35) for NHPI adults, compared to White adults.

*Conclusions:* Racial and ethnic health disparities persisted and, in many cases, worsened during and after the COVID-19 pandemic. AIAN and NHPI adults experienced the highest burden of chronic disease and mental health challenges, while Hispanic adults faced rising financial barriers to care. These patterns reflect longstanding structural inequities and highlight the urgent need for sustained, equity-focused public health investments, including culturally responsive services, expanded access to care, and long-term support for historically underserved communities.

## Introduction

The COVID-19 pandemic has served as both a magnifier and a mirror, intensifying existing health inequities and exposing the deep structural disparities embedded within the U.S. healthcare and socioeconomic systems (1,2). In Washington State, these disparities were especially stark among historically marginalized populations. Native Hawaiian and Pacific Islander (NHPI), American Indian and Alaska Native (AIAN), and other communities of color experienced COVID-19 case rates up to three times higher than other racial and ethnic groups (3). Socioeconomic disadvantages further intensified these health outcomes. Individuals from lower-income backgrounds faced mortality rates five times greater than those in higher socioeconomic strata, a reflection of long-standing barriers to healthcare access, occupational safety, and adequate housing (4,5). These adverse social determinants of health (SDoH)—such as food insecurity, overcrowded housing, and limited healthcare infrastructure—have created a cycle of vulnerability for Black, Hispanic, AIAN, and NPHI populations, amplifying risk during public health crises (6).

Despite increasing awareness of these inequities, gaps remain in our understanding of how COVID-19 has altered the trajectory of health disparities over time, particularly at local levels. Much of the existing literature has focused on national trends or broad demographic groupings, often overlooking the nuanced and evolving nature of disparities across smaller geographies such as Washington State (7). Moreover, there is limited quantitative research that examines shifts in disparities longitudinally or disentangles the roles of race, ethnicity, and socioeconomic status in shaping pandemic outcomes. As the pandemic progressed, it became clear that disparities were not static—they shifted in both intensity and form due to changing public health policies, access to vaccines, economic relief measures, and the geographic spread of the virus (8). Yet, few studies have tracked these shifts or evaluated how structural factors either mitigated or perpetuated disparities over different phases of the pandemic. This lack of granular, localized analysis hinders the development of targeted, equity-focused interventions and policy responses.

To address the evolving landscape of health inequities in Washington State during and after the COVID-19 pandemic, this thesis employs a systematic, data-driven approach to quantify changes in health disparities over time. Specifically, it evaluates dynamic shifts in key health indicators—mental health status, chronic disease prevalence, and healthcare access—across multiple racial/ethnic groups, while adjusting for socioeconomic status (SES), and sex. Using prevalence differences (PD) and prevalence ratios (PR) as core metrics, this study investigates how these outcomes varied before and after the onset of the pandemic and assesses whether long-standing disparities were exacerbated or mitigated. The specific aims of this study are as follows: (1) to examine how the prevalence of key health outcomes—including mental health distress (defined as ≥14 days of poor mental health in the past 30 days), healthcare access barriers (defined as being unable to see a doctor due to cost), and chronic disease burden—changed across racial/ethnic groups and pandemic time periods compared to White adults, adjusting for sex and SES (defined by individual variables of employment status and educational attainment), and (2) to evaluate whether racial/ethnic disparities in key health indicators, relative to White adults, changed across the pandemic periods. This research seeks to uncover the structural forces influencing these patterns throughout and after the pandemic. The findings aim to provide actionable insights to inform the development of equitable public health policies and community-based strategies that can strengthen resilience and promote health equity in the face of future public health emergencies.

## Methods

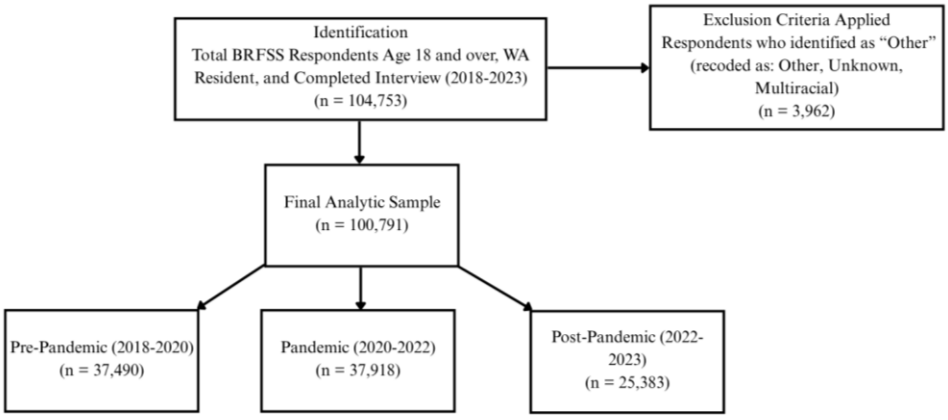
*Study Population and Design*

This retrospective observational study analyzed data from the Washington State Behavioral Risk Factor Surveillance System (BRFSS), an ongoing, population-based telephone survey of noninstitutionalized adults aged 18 years and older. The study population included all respondents who completed the BRFSS interview between 2018 and 2023, covering three distinct pandemic-related time periods: pre-pandemic (2018–2020), during the pandemic (2020–2022), and post-pandemic (2022–2023).

Eligibility criteria included current residency in Washington State, age 18 years or older, and full completion of the BRFSS interview. From an initial pool of 104,753 respondents, individuals who identified their race/ethnicity as "Other" ($n$ = 3,962), from the recoded race variable (individuals who identified as “Other,” “Unknown,” and “Multiracial” were recoded and categorized as “Other”) were excluded due to small and heterogeneous subgroup sizes (Figure 1). The final analytic sample comprised 100,791 respondents with complete sociodemographic and health information. As shown in Figure 1, this sample was subsequently stratified into three time periods based on survey year: pre-pandemic ($n$ = 37,490), during-pandemic ($n$ = 37,918), and post-pandemic ($n$ = 25,383).

All data were collected using BRFSS’s Computer-Assisted Telephone Interviewing (CATI) system and followed the Centers for Disease Control and Prevention’s (CDC) protocol for standardized data collection.

Figure 1. Flow diagram of study population.




*Primary Exposures and Outcome Measurement*

Primary exposures include pandemic period (pre-, during-, and post-pandemic) and self-identified race/ethnicity (Hispanic, White, Black, American Indian/Alaska Native [AIAN], Asian, and Native Hawaiian/Pacific Islander [NHPI]).

Primary outcomes captured three domains: healthcare access, mental health status, and chronic disease burden. Healthcare access: respondents were classified based on the following BRFSS question: "Was there a time in the past 12 months when you needed to see a doctor but could not because you could not afford it?" that was recoded as the binary indicator: unable to see a doctor due to cost in the past year (yes/no). This indicator was selected to represent healthcare access due to evidence indicating that financial barriers to healthcare access have been magnified during the COVID-19 pandemic, particularly among low-income and minority populations (9). Mental health: frequent mental distress was defined as ≥14 days of poor mental health in the past 30 days (10). Chronic disease: a composite indicator captured the presence (answered yes) of any of the following self-reported, physician-diagnosed conditions: asthma (current), diabetes, arthritis, chronic obstructive pulmonary disease (COPD), kidney disease, stroke, myocardial infarction, and angina or coronary heart disease (CHD).

*Demographics*

SES was assessed using two self-reported indicators: educational attainment (less than high school, high school graduate or GED, some college or technical school, and college graduate), and employment status (employed, unemployed, or retired). These variables were selected based on prior evidence linking them to structural health disparities, which have been magnified during the COVID-19 pandemic (1,4,5). Key demographics included age group (categorized as categorical: 18-24, 25-44, 45-54, 65+), educational attainment (less than high school, high school/GED, some college/technical school, college graduate), and employment status (employed, unemployed, retired). These were included based on established social determinants of health frameworks, recognizing their role in both exposure and outcome pathways, particularly during public health emergencies like COVID-19 (7,8). Income was excluded from analysis due missingness totaling over 20% (21,324) to maintain a higher statistical power in order to minimize Type II error.

Sex (male, female) was included in the models both as a main effect and in interaction terms with time period. However, the primary aims did not focus on sex differences, and therefore these estimates were not emphasized in the following interpretation.

*Statistical Analysis*

All analyses were performed using the Washington State and King County BRFSS dataset, prepared and validated by Public Health — Seattle & King County. These datasets have been standardized across the years to facilitate systematic comparisons over time. Descriptive statistics (weighted proportions and means) were used to describe the study population and assess distributions across race/ethnicity, SES, and sex subgroups.

For Aim 1, adjusted prevalence estimates, and prevalence differences (PDs) were derived using survey-weighted logistic regression models (svyglm) with a quasibinomial distribution and identity link in R version 4.4.2. Models included main effects and interaction terms between pandemic time periods and

key sociodemographic variables (e.g., race/ethnicity, sex), with additional adjustment for age (continuous), education (unordered factor), and employment status (unordered factor). This modeling approach was selected based on recommendations from Bieler et al, who demonstrated that generalized linear models with an identity link can be used to directly estimate risk differences from complex survey data (11). This method allows for intuitive interpretation of absolute disparities on the probability scale while accounting for the survey design, including weighting, stratification, and clustering. The quasibinomial distribution accounts for potential overdispersion in binary outcome data, improving the stability of variance estimates.

To ensure the stability of parameter estimates, multicollinearity was assessed among predictors using Generalized Variance Inflation Factors (GVIFs). Given the inclusion of interaction terms, adjusted GVIF values ($GVIF^{1/(2\times Df)}$) were interpreted. All adjusted GVIFs were below 2.2, indicating low to moderate multicollinearity and supporting the suitability of the model specifications.

Adjusted prevalences were estimated using the emmeans R package on the response (probability) scale, with proportional weighting, as recommended by Bieler et al. for generating model-adjusted estimates that reflect the weighted survey population (11). Pairwise contrasts were used to estimate PDs between time periods within each racial/ethnic group using post hoc comparisons with White adults chosen as the referent group. Utilizing the White population (adults) as the referent group in health disparities research is a prevalent practice, grounded in both methodological considerations and the historical context of public health studies with several studies employing the White population as the referent group to elucidate disparities in specific health outcomes (12–14).

For Aim 2, prevalence ratios (PRs) were estimated using survey-weighted Poisson regression models with a log link and robust standard errors. Interaction terms between time period and key exposures were included to account for effect modification. PRs were computed within each time period to evaluate disparities in prevalence between racial/ethnic groups, with White participants serving as the referent group. Model coefficients were exponentiated to obtain prevalence ratios (PRs) and 95% confidence intervals, which directly quantify disparities between racial/ethnic groups relative to White adults.

Statistical significance was determined at the two-sided $\alpha = 0.05$ level. Model fit was assessed using McFadden's pseudo $R^2$, a commonly used measure for evaluating logistic regression and related models fitted via maximum likelihood, for all adjusted prevalence estimates and PR models. All adjusted prevalence estimates, and PR models indicated modest improvement over the null model ($R^2$: 0.10-0.15) besides the mental health adjusted prevalence estimate model ($R^2$: 0.07), unable to see a doctor due to cost adjusted prevalence estimate model ($R^2$: 0.08), and mental health PR estimate model ($R^2$: 0.08). Values between 0.2 and 0.4 are often considered to indicate good fit, though lower values can be acceptable in models with complex data structures or large sample sizes (15).

**Results**

Table 1. Sociodemographic Characteristics of Washington State BRFSS Survey Respondents: Pre-, During-, Post- COIVD-19 Pandemic Periods

| Variable | Pre-Pandemic; 2018–2020 *n* (%) | Pandemic; 2020–2022 *n* (%) | Post-Pandemic; 2022–2023 *n* (%) | Total; 2018-2023 *n* (%) |
|---|---|---|---|---|
| ***n*[a]** | 37,490 (37.2%) | 37,918 (37.6%) | 25,383 (25.2%) | 100,791 (100%) |
| **Age Group** | | | | |
| 18-24 | 2,071 (11.2%) | 1,750 (10.6%) | 1,337 (11.2%) | 5,158 (10.9%) |
| 25-44 | 8,739 (35.5%) | 9,206 (35.8%) | 6,675 (34.6%) | 24,620 (35.4%) |
| 45-64 | 12,670 (32.3%) | 12,480 (31.2%) | 8,153 (30.9%) | 33,303 (33.1%) |
| 65 or older | 14,010 (21.0%) | 14,482 (22.4%) | 9,218 (23.3%) | 37,710 (22.1%) |
| **Sex** | | | | |
| Female | 19,928 (50.3%) | 19,937 (52.0%) | 13,332 (52.0%) | 53,197 (52.0%) |
| Male | 17,562 (49.7%) | 17,981 (48.0%) | 12,051 (48.0%) | 47,594 (48.0%) |
| **Race/Ethnicity** | | | | |
| AIAN | 527 (1.6%) | 446 (1.3%) | 269 (1.2%) | 1,242 (1.4%) |
| Asian | 1,416 (9.7%) | 1,950 (11.0%) | 1,486 (11.2%) | 4,852 (10.6%) |
| Black | 796 (3.5%) | 907 (4.2%) | 750 (4.2%) | 2,453 (4.0%) |
| Hispanic | 2,863 (11.1%) | 3,035 (12.1%) | 2,355 (13.3%) | 8,253 (12.1%) |

| | | | | |
|---|---|---|---|---|
| NHPI | 167 (0.5%) | 176 (0.8%) | 171 (0.9%) | 514 (0.7%) |
| White | 31,721 (73.6%) | 31,404 (70.6%) | 20,352 (64.9%) | 83,477 (68.0%) |
| **Education** | | | | |
| College Graduate | 15,763 (32.2%) | 17,899 (34.4%) | 11,989 (35.1%) | 45,651 (33.7%) |
| Some College/Technical School | 11,317 (34.5%) | 10,616 (33.2%) | 6,949 (32.5%) | 28,882 (33.5%) |
| High School Graduate/GED | 8,598 (23.4%) | 7,932 (23.2%) | 5,438 (23.3%) | 21,968 (23.3%) |
| <High School | 2,144 (9.8%) | 1,764 (9.2%) | 1,230 (9.3%) | 5,138 (9.4%) |
| **Employment** | | | | |
| Employed | 17,975 (69.0%) | 18,534 (68.7%) | 13,036 (68.7%) | 49,535 (68.8%) |
| Retired | 12,421 (23.7%) | 12,807 (24.7%) | 8,211 (25.4%) | 33,439 (24.5%) |
| Unemployed | 1,709 (7.2%) | 1,559 (6.7%) | 975 (5.9%) | 4,243 (6.7%) |
| *Missing* | 5,395 (14.4%) | 5,018 (13.2%) | 3,161 (12.5%) | 13,574 (13.5%) |
| **Chronic Disease Status** | | | | |
| Yes | 17,955 (39.0%) | 18,754 (41.1%) | 11,895 (40.0%) | 48,604 (40.0%) |
| *Missing* | 482 (1.3%) | 471 (1.2%) | 311 (1.2%) | 1,264 (1.3%) |

[a]Weighted sample sizes (*n*) are provided to indicate the number of respondents in the final analytic sample.

*Percentages are based on weighted data to account for survey design.
**Total missing data is less than 5% of the total final analytical sample and is excluded from analyses in the final analytical sample.
***Missing data is noted in italicized font and represents the percentage of the total sample size for that group. All other percentages are calculated excluding missing data from each variable.
Abbreviations: AIAN, American Indian or Alaska Native; NHPI, Native Hawaiian or Pacific Islander; GED, General Educational Development; COPD, chronic obstructive pulmonary disease; CHD, coronary heart disease.

*Sociodemographic Characteristics of Respondents*

A total of 104,753 Washington State adults participated, with the final analytic sample totaling 100,791 adults, in the Behavioral Risk Factor Surveillance System (BRFSS) from 2018 to 2023, with survey distribution consistent across pre-pandemic (37.2%), pandemic (37.6%), and post-pandemic (25.2%) periods (Table 1). Respondents were evenly split by sex, with 50.4% identifying as female and 49.6% as male. The sample included adults across all age groups, with approximately 11.2% aged 18–24 years, 35.5% aged 25–44 years, 32.3% aged 45–64 years, and 21.0% aged 65 years or older. The majority of respondents identified as White (68.0%), followed by Hispanic (12.1%), Asian (10.6%), Black (4.0%), American Indian/Alaska Native (AIAN, 1.4%), and Native Hawaiian/Pacific Islander (NHPI, 0.7%).

Table 2. Adjusted Prevalence of Key Health Indicators by Sex, Race/Ethnicity and Pre-, During-, and Post-Pandemic Periods, Washington State 2018-2023

| Race/ Ethnicity | Time Period | 14+ Mental Health Days Not Good % (95% CI) | Chronic Disease % (95% CI) | Unable to See Doctor Due to Cost in the Past Year % (95% CI) |
|---|---|---|---|---|
| AIAN | Pre | 9.2 (6.6, 12.7) | 54.9 (48.1, 61.5) | 9.2 (6.4, 13.1) |
| | During | 12.4 (8.9, 17.0) | 56.7 (49.0, 64.0) | 4.4 (2.6, 7.2) |
| | Post | 13.5 (8.9, 19.8) | 62.1 (52.7, 70.7) | 11.1 (7.1, 16.8) |
| Asian | Pre | 4.7 (3.6, 6.2) | 33.5 (29.7, 37.5) | 6.6 (5.1, 8.4) |
| | During | 5.4 (4.4, 6.6) | 39.5 (36.1, 42.9) | 3.5 (2.7, 4.7) |
| | Post | 7.4 (6.0, 9.2) | 39.8 (35.9, 43.8) | 4.8 (3.6, 6.4) |
| Black | Pre | 7.3 (5.6, 9.5) | 49.9 (45.1, 54.8) | 6.5 (4.9, 8.5) |
| | During | 8.9 (7.0, 11.2) | 47.5 (42.7, 52.4) | 7.5 (5.8, 9.7) |
| | Post | 9.5 (7.1, 12.6) | 51.5 (45.4, 57.6) | 7.0 (5.1, 9.4) |

| | | | | |
|---|---|---|---|---|
| Hispanic | Pre | 5.3 (4.4, 6.3) | 41.3 (38.4, 44.3) | 8.1 (7.1, 9.3) |
| | During | 7.3 (6.3, 8.4) | 43.7 (40.7, 46.6) | 9.6 (8.4, 10.9) |
| | Post | 6.8 (5.8, 8.0) | 43.6 (40.4, 47.0) | 10.3 (8.9, 11.8) |
| NHPI | Pre | 9.2 (5.4, 15.4) | 47.8 (36.6, 59.2) | 7.9 (4.4, 13.6) |
| | During | 9.6 (5.7, 15.5) | 62.0 (50.8, 72.1) | 6.0 (3.0, 11.6) |
| | Post | 8.3 (4.6, 14.5) | 63.5 (52.0, 73.7) | 12.0 (7.0, 19.7) |
| White | Pre | 8.3 (7.9, 8.7) | 46.2 (45.3, 47.0) | 6.3 (6.0, 6.7) |
| | During | 10.8 (10.3, 11.3) | 49.3 (48.4, 50.2) | 5.6 (5.2, 5.9) |
| | Post | 10.5 (10.0, 11.1) | 46.8 (45.7, 47.9) | 5.5 (5.1, 6.0) |

Abbreviations: AIAN, American Indian or Alaska Native; NHPI, Native Hawaiian or Pacific Islander.
*Prevalence results adjusted for: sex, age, education, employment.

Table 3. Prevalence Differences of Key Health Indicators Compared to White Adults by Race/Ethnicity Across All Pandemic Periods, Washington State, 2018-2023

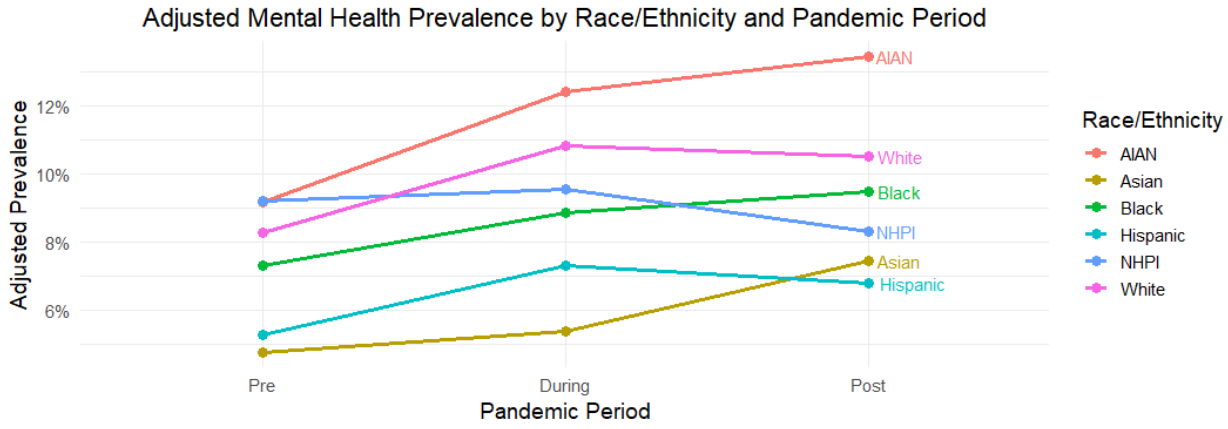
| **Race/Ethnicity (ref: White)**<br>**Health Indicator:** 14+ Mental health days not good | **Time Period** | **Prevalence Difference (SE)** | **p-value** |
|---|---|---|---|
| AIAN | Pre | 0.9 (1.6) | 0.94 |
| | During | 1.6 (2.1) | 0.86 |
| | Post | 2.9 (2.7) | 0.70 |
| Asian | Pre | -3.5 (0.7) | <0.05 |
| | During | -5.4 (0.6) | <0.05 |
| | Post | -3.1 (0.9) | <0.05 |
| Black | Pre | -1.0 (1.0) | 0.74 |
| | During | -2.0 (1.1) | 0.27 |
| | Post | -1.1 (1.4) | 0.87 |
| Hispanic | Pre | -3.0 (0.5) | <0.05 |
| | During | -3.5 (0.6) | <0.05 |

| | | | |
|---|---|---|---|
| | Post | -3.7 (0.6) | <0.05 |
| NHPI | Pre | 0.9 (2.5) | 0.98 |
| | During | -1.3 (2.4) | 0.95 |
| | Post | -2.2 (2.5) | 0.79 |
| **Health Indicator:** Chronic Disease | **Time Period** | **Prevalence Difference (SE)** | **p-value** |
| AIAN | Pre | 8.7 (3.5) | <0.05 |
| | During | 7.4 (3.9) | 0.21 |
| | Post | 15.3 (4.7) | <0.05 |
| Asian | Pre | -12.7 (2.0) | <0.05 |
| | During | -9.8 (1.8) | <0.05 |
| | Post | -7.0 (2.1) | <0.05 |
| Black | Pre | 3.8 (2.5) | 0.43 |
| | During | -1.7 (2.5) | 0.89 |
| | Post | 4.7 (3.2) | 0.43 |
| Hispanic | Pre | -4.8 (1.6) | <0.05 |
| | During | -5.6 (1.6) | <0.05 |
| | Post | -3.2 (1.8) | 0.27 |
| NHPI | Pre | 1.6 (5.9) | 0.99 |
| | During | 12.7 (5.5) | 0.09 |
| | Post | 16.7 (5.7) | <0.05 |
| **Health Indicator:** Unable to See Doctor Due to Cost in the Past Year | **Time Period** | **Prevalence Difference (SE)** | **p-value** |
| AIAN | Pre | 2.9 (1.7) | 0.31 |
| | During | -1.2 (1.2) | 0.70 |
| | Post | 5.6 (2.4) | 0.09 |
| Asian | Pre | 0.3 (0.8) | 0.99 |
| | During | -2.0 (0.5) | <0.05 |

| | | | |
|---|---|---|---|
| | Post | -0.7 (0.7) | 0.76 |
| Black | Pre | 0.1 (0.9) | 1.00 |
| | During | 2.0 (1.0) | 0.18 |
| | Post | 1.4 (1.1) | 0.55 |
| Hispanic | Pre | 1.8 (0.6) | <0.05 |
| | During | 4.0 (0.6) | <0.05 |
| | Post | 4.7 (0.7) | <0.05 |
| NHPI | Pre | 1.5 (2.3) | 0.90 |
| | During | 0.4 (2.1) | 1.00 |
| | Post | 6.4 (3.2) | 0.16 |

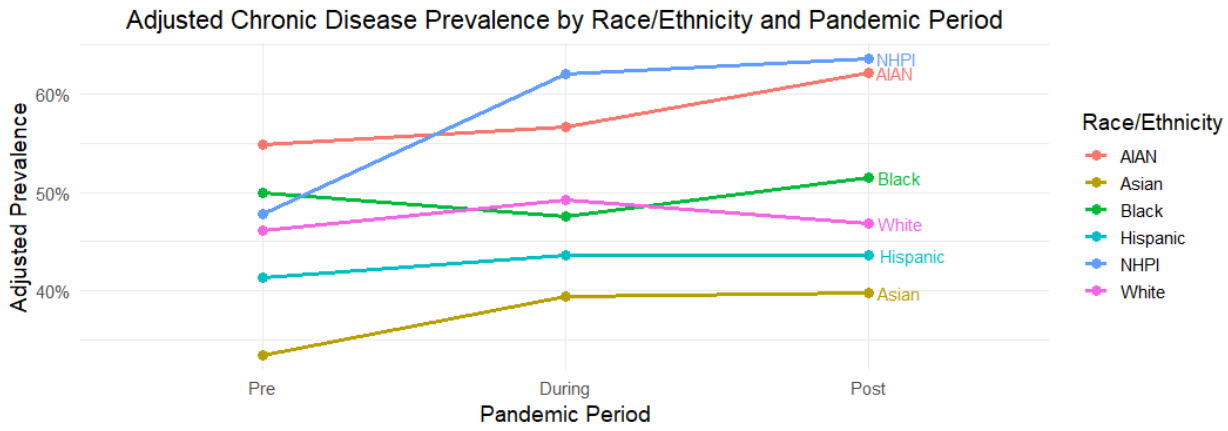
Abbreviations: AIAN, American Indian or Alaska Native; NHPI, Native Hawaiian or Pacific Islander; SE, Standard Error.
*Prevalence difference results averaged over: sex, age, education, employment.

Figure 2. Adjusted Mental Health Prevalence by Race/Ethnicity and Pandemic Period



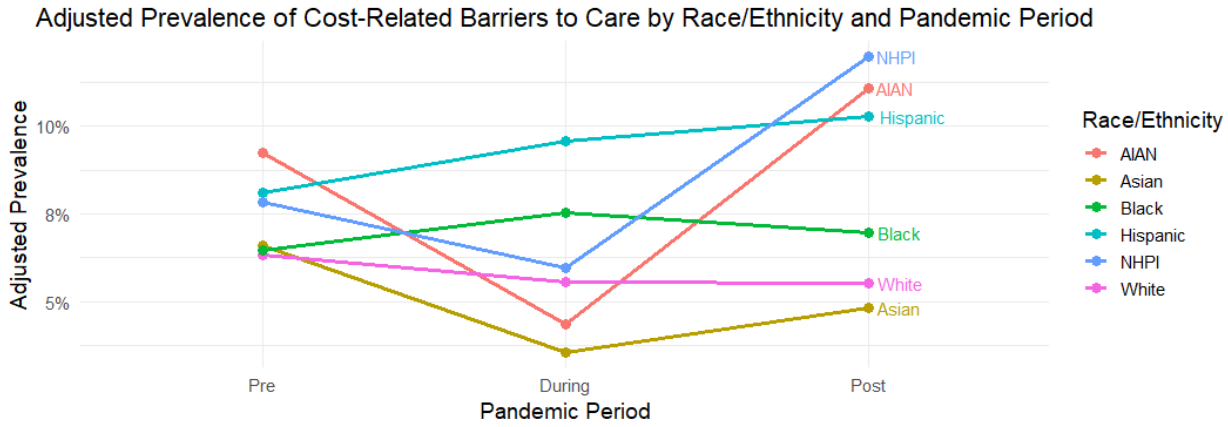

Abbreviations: AIAN, American Indian or Alaska Native; NHPI, Native Hawaiian or Pacific Islander.

Figure 3. Adjusted Chronic Disease Prevalence by Race/Ethnicity and Pandemic Period




Abbreviations: AIAN, American Indian or Alaska Native; NHPI, Native Hawaiian or Pacific Islander.

Figure 4. Adjusted Cost-Related Barriers to Care (unable to see a doctor due to cost) Prevalence by Race/Ethnicity and Pandemic Period




Abbreviations: AIAN, American Indian or Alaska Native; NHPI, Native Hawaiian or Pacific Islander.

*Aim 1: Trends in Key Health Indicators by Race/Ethnicity and Pandemic Period compared to White Adults*

Adjusted prevalence of frequent poor mental health (≥14 days of poor mental health in the past 30 days) increased during the pandemic for most racial and ethnic groups in Washington State (Table 2 and Figure 2). Among American Indian or Alaska Native (AIAN) adults, prevalence rose from 9.2% (95% confidence interval (CI): 6.6, 12.7) in the pre-pandemic period to 13.5% (95% CI: 8.9, 19.8) post-pandemic (Table 2 and Figure 2). Black adults also had an increase in prevalence throughout the pandemic periods from 7.3% (95% CI: 5.6, 9.5) pre-pandemic, to 8.9% (95% CI: 7.0, 11.2) during-pandemic, and finally to 9.5% (95% CI: 7.1, 12.6) post-pandemic period (Table 2 and Figure 2). Whereas Native Hawaiian or Pacific Islander (NHPI) adults experienced a decreased prevalence in the post-pandemic period (8.3%; 95% CI: 4.6, 14.5) from pre- (9.2%; 95% CI: 5.4, 15.4) and during-pandemic

(9.6%; 95% CI: 5.7, 15.5) periods (Table 2 and Figure 2). Prevalence among White adults increased from 8.3% (95% CI: 7.9, 8.7) pre-pandemic to 10.5% (95% CI: 10.0, 11.1) post-pandemic. Across all three periods, Asian and Hispanic adults had consistently statistically significant ($p < 0.05$) lower prevalence of frequent poor mental health than White adults (Table 3). Relative to White adults, adjusted prevalence differences for Asian adults were -3.5 (Standard Error (SE): 0.7), -5.4 (SE: 0.6), and -3.1 (SE: 0.9) percentage points in the pre-, during-, and post-pandemic periods, respectively ($p < 0.05$ for all comparisons; Table 3). Hispanic adults had adjusted prevalence differences of -3.0 (SE: 0.5), -3.5 (SE: 0.6), and -3.7 (SE: 0.6) percentage points across the same periods ($p < 0.05$ for all comparisons; Table 3).

Chronic disease prevalence was highest among AIAN and NHPI adults across all pandemic periods compared to the prevalence of White adults (Table 2 and Table 3). Figure 3 shows that the adjusted prevalence of chronic disease increased pre-pandemic from post-pandemic for all racial/ethnic groups. Post-pandemic, the adjusted prevalence among AIAN adults reached 62.1% (95% CI: 52.7, 70.7), and among NHPI adults, 63.5% (95% CI: 52.0, 73.7), compared to 46.8% (95% CI: 45.7, 47.9) among White adults (Table 2). The corresponding adjusted prevalence differences relative to White adults in the post-pandemic period were +15.3 percentage points (SE: 4.7; $p < 0.05$) for AIAN adults and +16.7 percentage points (SE: 5.7; $p < 0.05$) for NHPI adults (Table 3). Asian and Hispanic adults consistently had lower chronic disease prevalence compared to White adults. For instance, post-pandemic prevalence was 39.8% (95% CI: 35.9, 43.8) among Asian adults and 43.6% (95% CI: 40.4, 47.0) among Hispanic adults. In the same period, the adjusted difference for Asian adults was -7.0 percentage points (SE: 2.1; $p < 0.05$) (Table 3).

For being unable to see a doctor due to cost in the past year, the post-pandemic prevalence was highest among NHPI adults (12.0%; 95% CI: 7.0, 19.7) and AIAN adults (11.1%; 95% CI: 7.1, 16.8) (Table 2 and Figure 4), although these differences were not statistically significant compared to White adults (Table 3). Hispanic adults consistently had higher adjusted prevalence of cost-related barriers relative to White adults, with differences of +1.8 (SE: 0.6), +4.0 (SE: 0.6), and +4.7 (SE: 0.7) percentage points in the pre-, during-, and post-pandemic periods, respectively ($p < 0.05$ for all comparisons; Table 3). Asian adults reported significantly lower cost-related barriers during the pandemic (adjusted difference: -2.0; SE: 0.5; $p < 0.05$; Table 3), but not in the pre- or post-pandemic periods.

Table 4. Adjusted Prevalence Ratios (PRs) by Race/Ethnicity and Pandemic Period Compared to White Adults, Washington State, 2018-2023

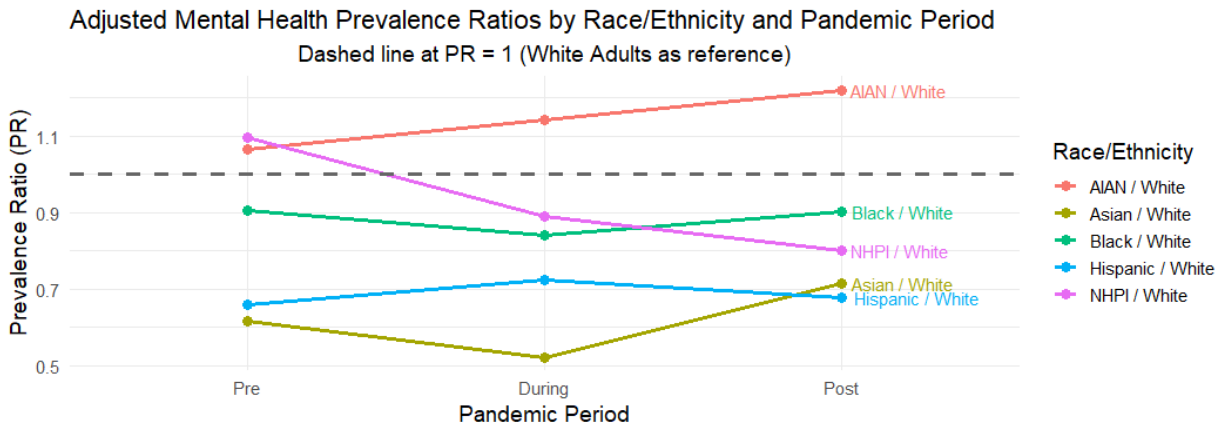
| **Race/Ethnicity (ref: White)**<br>**Health Indicator:**<br>14+ Mental health days not good | **Time Period** | **Prevalence Ratio (95% CI)** | **p-value** |
|---|---|---|---|
| AIAN | Pre | 1.07 (0.74–1.54) | 0.97 |
| | During | 1.14 (0.79–1.65) | 0.78 |

| | | | |
|---|---|---|---|
| | Post | 1.22 (0.78–1.91) | 0.66 |
| Asian | Pre | 0.62 (0.45–0.85) | <0.05 |
| | During | 0.52 (0.41–0.67) | <0.05 |
| | Post | 0.72 (0.55–0.94) | <0.05 |
| Black | Pre | 0.91 (0.66–1.24) | 0.84 |
| | During | 0.84 (0.64–1.11) | 0.39 |
| | Post | 0.90 (0.64–1.27) | 0.86 |
| Hispanic | Pre | 0.66 (0.53–0.82) | <0.05 |
| | During | 0.72 (0.61–0.86) | <0.05 |
| | Post | 0.68 (0.55–0.83) | <0.05 |
| NHPI | Pre | 1.10 (0.61–1.96) | 0.97 |
| | During | 0.89 (0.52–1.51) | 0.94 |
| | Post | 0.80 (0.42–1.52) | 0.81 |
| **Health Indicator:** Chronic Disease | **Time Period** | **Prevalence Ratio (95% CI)** | **p-value** |
| AIAN | Pre | 1.20 (1.03–1.39) | <0.05 |
| | During | 1.17 (0.98–1.38) | 0.10 |
| | Post | 1.34 (1.11–1.62) | <0.05 |
| Asian | Pre | 0.70 (0.60–0.82) | <0.05 |
| | During | 0.80 (0.71–0.90) | <0.05 |
| | Post | 0.84 (0.74–0.96) | <0.05 |
| Black | Pre | 1.09 (0.95–1.25) | 0.36 |
| | During | 0.97 (0.85–1.12) | 0.96 |
| | Post | 1.13 (0.95–1.34) | 0.27 |
| Hispanic | Pre | 0.88 (0.79–0.99) | <0.05 |
| | During | 0.86 (0.78–0.96) | <0.05 |
| | Post | 0.93 (0.83–1.05) | 0.46 |
| NHPI | Pre | 1.06 (0.75–1.49) | 0.97 |

| | | | |
|---|---|---|---|
| | During | 1.34 (1.02–1.77) | <0.05 |
| | Post | 1.44 (1.08–1.91) | <0.05 |
| **Health Indicator:** Unable to See Doctor Due to Cost in the Past Year | **Time Period** | **Prevalence Ratio (95% CI)** | **p-value** |
| AIAN | Pre | 1.43 (0.95–2.17) | 0.11 |
| | During | 0.78 (0.42–1.48) | 0.75 |
| | Post | 1.86 (1.13–3.06) | <0.05 |
| Asian | Pre | 1.04 (0.76–1.42) | 0.99 |
| | During | 0.65 (0.46–0.93) | <0.05 |
| | Post | 0.87 (0.60–1.26) | 0.77 |
| Black | Pre | 1.04 (0.74–1.46) | 0.99 |
| | During | 1.30 (0.96–1.78) | 0.12 |
| | Post | 1.22 (0.84–1.77) | 0.53 |
| Hispanic | Pre | 1.29 (1.08–1.54) | <0.05 |
| | During | 1.60 (1.34–1.90) | <0.05 |
| | Post | 1.71 (1.40–2.07) | <0.05 |
| NHPI | Pre | 1.26 (0.66–2.42) | 0.79 |
| | During | 1.03 (0.46–2.31) | 1.00 |
| | Post | 1.93 (1.12–3.35) | <0.05 |

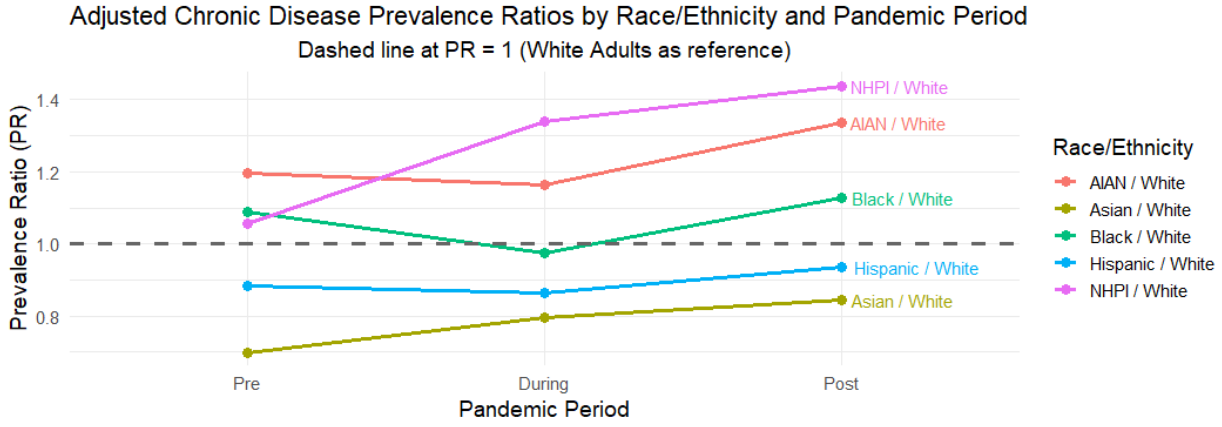
*Note:* PRs are adjusted for sex, age, education, employment.
Abbreviations: AIAN, American Indian or Alaska Native; NHPI, Native Hawaiian or Pacific Islander; 95% CI, 95% Confidence Interval.

Figure 5. Mental Health Adjusted Prevalence Ratios by Race/Ethnicity and Pandemic Period



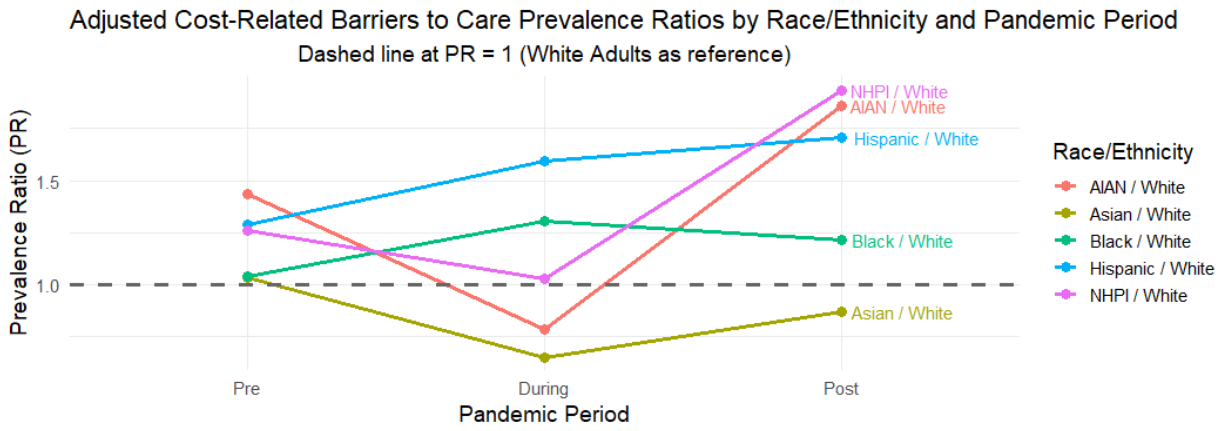

Abbreviations: AIAN, American Indian or Alaska Native; NHPI, Native Hawaiian or Pacific Islander.

Figure 6. Chronic Disease Adjusted Prevalence Ratios by Race/Ethnicity and Pandemic Period




Abbreviations: AIAN, American Indian or Alaska Native; NHPI, Native Hawaiian or Pacific Islander.

Figure 7. Cost-Related Barriers to Care (Unable to see a doctor due to cost) Adjusted Prevalence Ratios by Race/Ethnicity and Pandemic Period




Abbreviations: AIAN, American Indian or Alaska Native; NHPI, Native Hawaiian or Pacific Islander.

*Aim 2: Racial/Ethnic Disparities in Key Health Indicators Relative to White Adults Across the Pandemic Periods*

Adjusted prevalence ratios (PRs) for poor mental health, chronic disease, and cost-related barriers (being unable to see a doctor due to cost) to care are presented by race/ethnicity and pandemic period (Table 4).

Asian and Hispanic adults consistently reported significantly lower adjusted PR of frequent poor mental health days compared to White adults across all time periods. Among Asian adults, PRs were significantly lower in the pre-pandemic (PR: 0.62; 95% CI: 0.45–0.85), during-pandemic (PR: 0.52; 95% CI: 0.41–0.67), and post-pandemic (PR: 0.72; 95% CI: 0.55–0.94) periods (all $p < 0.05$) (Table 4). Similarly, Table 4 shows that Hispanic adults had a lower PR pre-pandemic (PR: 0.66; 95% CI: 0.53–0.82), during (PR: 0.72; 95% CI: 0.61–0.86), and post-pandemic (PR: 0.68; 95% CI: 0.55–0.83) (all $p < 0.05$). No statistically significant differences were observed for AIAN, Black, or NHPI adults compared to White adults during any period.

Compared to White adults, Asian adults had significantly lower adjusted PR of any chronic disease in all time periods (Table 4 and Figure 6). For Asian adults, PRs were 0.70 (95% CI: 0.60–0.82) pre-pandemic, 0.80 (95% CI: 0.71–0.90) during, and 0.84 (95% CI: 0.74–0.96) post-pandemic (all $p < 0.05$) (Table 4). Hispanic adults showed a similar trend: 0.88 (95% CI: 0.79–0.99) pre-pandemic, 0.86 (95% CI: 0.78–0.96) during, and 0.93 (95% CI: 0.83–1.05) post-pandemic compared to White adults (Figure 6), although the post-pandemic estimate was not statistically significant (Table 4). In contrast, AIAN adults had significantly higher chronic disease PR pre-pandemic (PR: 1.20; 95% CI: 1.03–1.39) and post-pandemic (PR: 1.34; 95% CI: 1.11–1.62) (both $p < 0.05$) compared to White adults (Table 4 and Figure 6). NHPI adults also had higher PR post-pandemic (PR: 1.44; 95% CI: 1.08–1.91; $p < 0.05$), with an increase during the pandemic (PR: 1.34; 95% CI: 1.02–1.77; $p < 0.05$) compared to White adults (Table 4 and Figure 6). No significant differences were observed for Black adults compared to White adults across time periods (Table 4).

Hispanic adults reported a significantly higher PR of being unable to see a doctor due to cost across all periods compared to White adults: pre-pandemic (PR: 1.29; 95% CI: 1.08–1.54), during (PR: 1.60; 95% CI: 1.34–1.90), and post-pandemic (PR: 1.71; 95% CI: 1.40–2.07) (all $p < 0.05$) (Table 4 and Figure 7). Table 4 and Figure 7 show that AIAN adults had significantly elevated PR in the post-pandemic period compared to White adults (PR: 1.86; 95% CI: 1.13–3.06; $p < 0.05$), although estimates during other periods were not significant (Table 4). Similarly, NPHI adults had significantly higher PR post-pandemic compared to White adults (PR: 1.93; 95% CI: 1.12–3.35; $p < 0.05$), however other estimates during other periods were not significant (Table 4). Asian adults had a significantly lower PR during the pandemic compared to White adults (PR: 0.65; 95% CI: 0.46–0.93; $p < 0.05$), while no statistically significant differences were observed in the pre- or post-pandemic periods (Table 4). No significant differences were found for Black adults during any time point.

## Discussion

In this retrospective observational study using Washington State Behavioral Risk Factor Surveillance System data (2018–2023), this study examined how racial and ethnic disparities in chronic disease, mental health, and healthcare access (being unable to see a doctor due to cost) evolved before, during, and after the COVID-19 pandemic. Findings reveal that not only did disparities persist across the pandemic periods, but in many cases, they widened, especially when comparing the different racial/ethnic groups to White adults.

Disparities in mental health became more pronounced during the pandemic. The adjusted prevalence of frequent poor mental health (≥14 mentally unhealthy days in the past 30 days) rose across nearly all racial and ethnic groups, despite not all differences in prevalence reaching statistical significance. AIAN adults experienced the highest post-pandemic prevalence at 13.5% (95% CI: 8.9–19.8), an increase from 9.2% (95% CI: 6.6–12.7) pre-pandemic. These findings align with national data documenting the disproportionate psychological toll of COVID-19 on AIAN communities—stemming from collective grief, cultural loss, and under-resourced behavioral health systems (4,7,11). However, in contrast, Asian and Hispanic adults consistently reported lower adjusted prevalence and PRs for poor mental health relative to White adults across all periods. Notably, mental health disparities between Asian and White adults narrowed post-pandemic, driven by a steeper relative increase among Asian adults, an emerging trend that merits further investigation. For example, post-pandemic prevalence was 7.4% for Asian adults (PR: 0.72; 95% CI: 0.55–0.94) and 6.8% for Hispanic adults (PR: 0.68; 95% CI: 0.55–0.83), compared to 10.5% for White adults. While these lower estimates may reflect protective cultural values and social cohesion, they may also be influenced by underreporting due to stigma and cultural norms surrounding mental health (10,14).

Consistent with longstanding evidence (2,4,6), AIAN and NHPI adults experienced the highest burden of chronic disease across all pandemic periods. In the post-pandemic period, adjusted chronic disease prevalence reached 62.1% (95% CI: 52.7–70.7) for AIAN adults and 63.5% (95% CI: 52.0–73.7) for NHPI adults, compared to 46.8% (95% CI: 45.7–47.9) for White adults—representing disparities of over 15 percentage points. Adjusted prevalence ratios (PRs) were significantly higher for AIAN (PR: 1.34; 95% CI: 1.10, 1.63) and NHPI adults (PR: 1.44; 95% CI: 1.08–1.91) post-pandemic. These widening gaps

potentially reflect structural drivers of chronic disease inequities, including underinvestment in tribal and territorial health infrastructure, high rates of employment in frontline occupations, and reduced access to preventive services (5,6). The widening of these gaps post-pandemic are suggestive that emergency public health responses did not adequately address underlying structural conditions that perpetuate chronic disease risk in these populations (1,6).

Cost-related barriers to accessing care (i.e., being unable to see a doctor due to cost) remained disproportionately high among Hispanic adults compared to White adults across all pandemic periods. Pre-pandemic, Hispanic adults had a prevalence difference of +1.8 (SE: 0.6; $p < 0.05$) percentage points compared to White adults during the same period, a difference of +4.0 (SE: 0.6; $p < 0.05$) during the pandemic, and a difference of +4.7 (SE: 0.7; $p < 0.05$) percentage points post-pandemic compared to White adults. Post-pandemic, 11.1% (95% CI: 7.1–16.8) of AIAN adults and 12.0% (95% CI: 7.0–19.7) of NHPI adults reported being unable to see a doctor due to cost, compared to 5.5% (95% CI: 5.1–6.0) of White adults post-pandemic. These results align with national findings that show marginalized groups still facing financial barriers despite federal relief efforts and Medicaid expansions (3,9). The continued or rising burden of cost-related barriers (i.e., being unable to see a doctor due to cost) for these groups suggests that pandemic-era policies did not adequately address the affordability of care for all communities.

This study contributes to the literature by providing locally grounded, longitudinal estimates of health disparities across multiple pandemic phases. While national data are critical for informing policy, regional analyses such as this are essential for identifying and addressing context-specific inequities that might otherwise be obscured (7,8). By adjusting for sociodemographic characteristics including age, sex, education, and employment, this study offers robust estimates of racial and ethnic differences in health outcomes.

Several limitations should be acknowledged. All data were self-reported, introducing potential recall or social desirability bias—particularly for sensitive topics like mental health (10). The BRFSS sampling frame may underrepresent populations at highest risk, including non-English-speaking or unhoused individuals, limiting generalizability. The inability to account for income due to its missing values representing over 20% of the study population, an important proxy for SES, represents another limitation that was faced during this study. Similarly, the missing values for education representing 13.5% of the study population that was functionally not used in regression analysis, is another limitation identified during this study, which may impact the study's statistical power and potentially introduce Type II error. Additionally, while this study defined the post-pandemic period through 2023, the longer-term health impacts of the pandemic may not yet be fully realized. Continued monitoring and surveillance is essential.

In conclusion, this study finds that racial and ethnic disparities in mental health, chronic disease, and healthcare access often widened throughout the COVID-19 pandemic. AIAN and NHPI adults were found bearing the highest burden of chronic disease compared to White adults during select pandemic time periods, while Hispanic adults experienced growing cost-related barriers in comparison to White adults. These findings underscore the urgency of sustained, equity-oriented reforms—including affordable access to care, culturally responsive mental health services, and long-term investments in community-based health systems tailored to the needs of historically marginalized populations (1,2,5). Without such

structural changes, short-term policy responses may yield only temporary gains, allowing inequities to persist or worsen in future public health emergencies.

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