

Abstract

This paper investigates the relationship between socioeconomic and demographic factors and self-reported health outcomes in U.S. adults, using data from the Behavioral Risk Factor Surveillance System (BRFSS) from 1993 to 2019. The BRFSS provides an extensive, nationally representative dataset on health behaviors, chronic conditions, and access to care. We focus on three key outcomes: mental health burden (average poor mental health days), racial distribution by income, and trends in poor or fair health by education level. Our analysis reveals persistent disparities across multiple dimensions. We find that individuals with lower income consistently report more poor mental health days than medium-income individuals across all age groups, suggesting that income-related stressors may contribute to greater mental health burden. Racial disparities are evident in income distribution, with Black, Asian, and Other/Multi-racial respondents making up a higher percentage of low-income respondents compared to medium-income respondents, underscoring systemic inequities. Additionally, educational attainment shows a strong association with self-reported health outcomes: individuals lacking a high school diploma report significantly higher rates of poor or fair health than college graduates over time. These disparities persist despite changes in public health policies and interventions over nearly three decades. We discuss limitations such as missing data, shifts in survey methodology, and the challenges of using self-reported measures. Our findings highlight the need for targeted public health interventions and policies that address structural determinants of health. Future research could extend this work by incorporating geographic analysis, exploring intersectionality among variables, and applying predictive models to forecast health outcomes under different policy scenarios.

Introduction

Health disparities in the United States have been the focus of extensive research, yet they remain a persistent challenge for public health professionals, policymakers, and communities. Despite numerous interventions and growing awareness, gaps in health outcomes across socioeconomic and demographic groups continue to be a defining feature of the U.S. health system. Socioeconomic status, race, and education are among the most critical determinants influencing health outcomes, shaping differences in disease prevalence, life expectancy, and quality of life across population groups. Understanding these disparities is not only an academic exercise but a necessary step

toward designing effective interventions, developing equitable policies, and allocating resources in a way that promotes health equity.

The relationship between income and health has long been established in both domestic and international contexts: individuals with higher incomes tend to have better health outcomes, greater access to healthcare services, healthier living conditions, and longer life expectancy. Income influences health both directly—by determining access to healthcare, healthy food, and safe housing—and indirectly, through its effect on living conditions, stress levels, employment opportunities, and exposure to environmental risks. Similarly, racial disparities in health reflect the cumulative impact of systemic racism, discrimination, residential segregation, and unequal access to educational and economic opportunities. Education, meanwhile, serves as a powerful predictor of health literacy, employment potential, income level, and access to information, each of which are essential for achieving and maintaining health.

This paper examines the intersection of income, race, and education in shaping self-reported health outcomes in U.S. adults, using data from the Behavioral Risk Factor Surveillance System (BRFSS) covering 1993 to 2019. The BRFSS is the largest continuously conducted health survey system in the world, providing a unique opportunity to assess trends over nearly three decades. By analyzing long-term patterns, we aim to determine whether health disparities have narrowed, persisted, or widened over time. Our analysis is motivated by ongoing policy debates and public health efforts aimed at eliminating health disparities, aligning with goals outlined by Healthy People initiatives and other national health equity frameworks.

Our study focuses on three key outcomes: (1) average poor mental health days by age and income, (2) racial distribution across income groups, and (3) trends in poor or fair health status by education level. Each of these outcomes provides insight into different facets of health inequity. Mental health days offer a window into psychological well-being and stress exposure; income stratification by race reflects broader economic inequities tied to historical and systemic racism; and educational disparities in health outcomes point to structural barriers in access to resources, knowledge, and opportunity.

The motivation for this study is grounded in the persistent and complex nature of health disparities in the U.S., which have resisted significant reduction despite decades of intervention. Public health agencies such as the CDC, state health departments, and community-based organizations can benefit from understanding where disparities are most pronounced and how they evolve over time. These insights can inform the design of targeted interventions, resource allocation, and evaluation of policy effectiveness. By

highlighting which groups bear disproportionate burdens, our findings can help prioritize public health efforts toward equity.

Moreover, our analysis contributes to the broader literature by updating prior findings with more recent data and by examining trends over an extended timeframe. Previous studies have documented disparities in health outcomes using snapshots of data or limited timeframes; our work extends this by providing a longitudinal view across multiple decades. This long-term perspective is critical for evaluating the impact of policy changes, healthcare reforms, and socioeconomic shifts. It allows for exploration of whether initiatives such as Medicaid expansions, the Affordable Care Act, or state-level reforms have translated into measurable reductions in health disparities.

In addition to updating the empirical evidence on health disparities, this paper seeks to highlight areas where interventions might have the most significant impact. By identifying which groups experience the greatest burden, policymakers can design interventions that are both equitable and effective. Furthermore, understanding how disparities have changed—or remained constant—over nearly thirty years provides valuable insight into the durability of structural inequities and the resilience of disparities in the face of policy interventions.

Another motivation for this study is to explore the potential of publicly available health surveillance data as a tool for ongoing monitoring of health disparities. The BRFSS offers a wealth of information that can inform public health practice, yet leveraging this data for actionable insights requires careful analysis and interpretation. Our approach demonstrates how this data can be used to identify persistent gaps and opportunities for improvement, while also illustrating the limitations of relying solely on self-reported survey data.

In the sections that follow, we describe the dataset and variables used in the analysis (Section 2), outline the methods used for data cleaning and preparation (Section 3), present the key results including tables and figures summarizing health disparities (Section 4), and conclude with a discussion of findings, limitations, and directions for future research (Section 5). Our goal is to provide a comprehensive yet accessible examination of how income, race, and education intersect to shape health outcomes in the United States, with implications for research, policy, and practice.

Data

We use the Behavioral Risk Factor Surveillance System (BRFSS), a national survey managed by the Centers for Disease Control and Prevention (CDC). The BRFSS collects data on health-related behaviors, chronic conditions, and access to care from

U.S. adults annually. Our dataset covers the years 1993 to 2019, representing nearly three decades of health trends.

Key variables included:

- Health Outcomes: GENHLTH, MENTHLTH, _MENT14D, _RFHLTH
- Socioeconomic Predictors: _INCOMG, _EDUCAG, _RACEGR3/_RACEGR4, _SEX/SEXVAR, _AGEG5YR
- Access to Care: _HLTHPL1, MEDCOST, PERSDOC2, CHECKUP1
- Demographic/Contextual: _URBSTAT, _STATE, _GEOSTR

The survey methodology evolved over time: landline-only sampling was used from 1993–2009, with cell phones added in 2011 to improve coverage. Weighting shifted from post-stratification to ranking in 2011 to better match demographic distributions.

Methods

Our analysis required merging datasets across years and harmonizing variable names. The cleaning strategy involved the following steps:

1. Merging individual year files into one dataset.
2. Standardize variable names and recording variables to ensure consistency.
3. Manually deriving variables missing in early years (e.g., computing _MENT14D from MENTHLTH).
4. Filtering incomplete responses and focusing on adults with valid data.
5. Applying appropriate weights to account for changes in survey methodology.
6. Checking distributions and removing outliers where necessary.

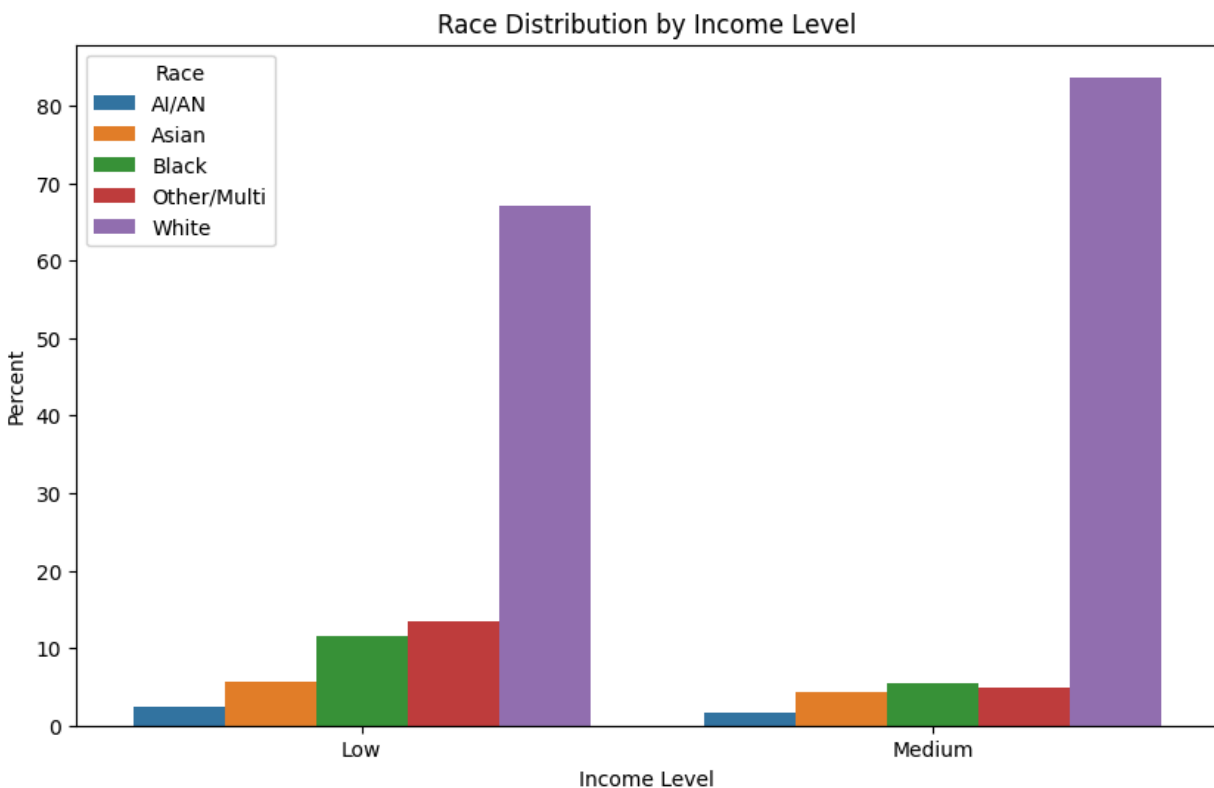
We focused our analysis on three main outcomes: average poor mental health days by age and income, racial distribution by income, and trends in poor/fair health by education.

Results

Average Poor Mental Health Days by Age and Income

We observe a clear pattern: average poor mental health days increase with age across both income groups. Individuals in the low-income group consistently report more poor mental health days than those in the medium-income group. For example, among those aged 80+, low-income individuals reported an average of 73.6 poor mental health days, compared to 75.9 for medium-income individuals. This finding highlights disparities in mental health burden by income and age.

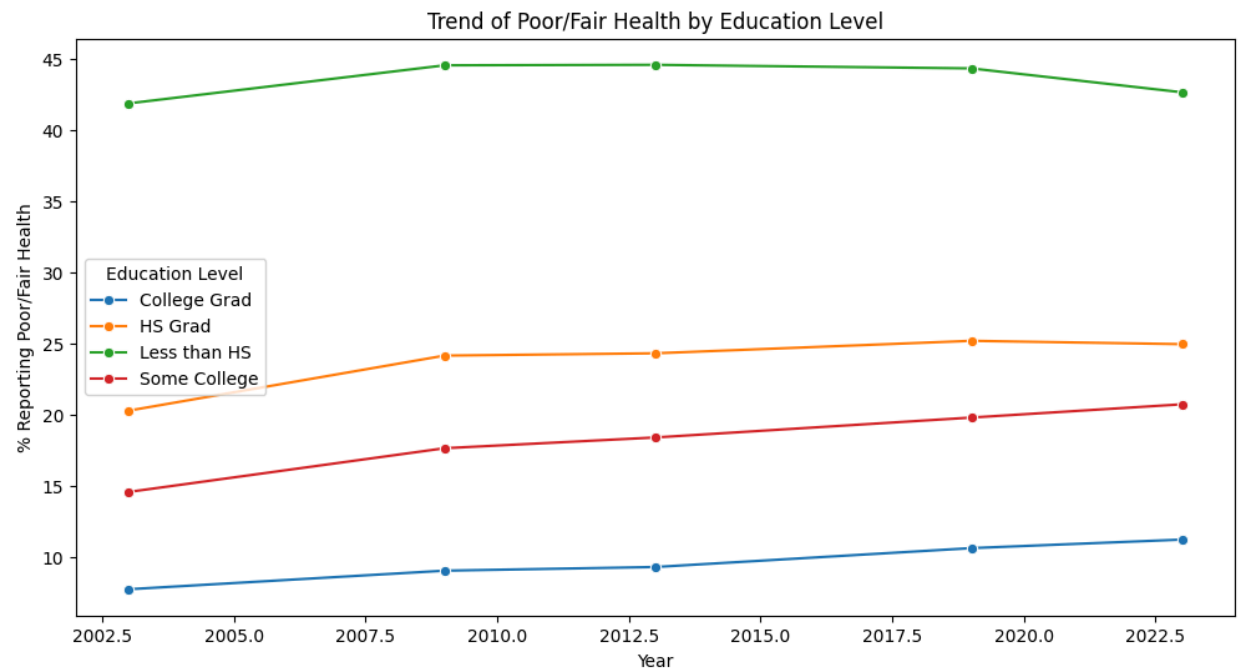
Race Distribution by Income Level



We find that White respondents make up the majority of both income groups, accounting for approximately 67% in the low-income group and 84% in the medium-income group. Meanwhile, Black, Asian, and Other/Multi-racial respondents are

overrepresented in the low-income group compared to the medium-income group. This visualization highlights disparities in income distribution across racial groups.

Trend of Poor/Fair Health by Education Level



We observed that educational attainment is strongly associated with self-reported health: those with less than a high school education consistently report the highest rates of poor/fair health (~43–45%), while college graduates report the lowest (~8–11%) across the years studied. The gap persists over time, with slight fluctuations but no evidence of convergence. This underscores education as a persistent predictor of health disparities.

Conclusion

Our analysis of the BRFSS dataset from 1993 to 2019 revealed persistent disparities in health outcomes across different demographic and socioeconomic groups. We found that individuals in lower income brackets consistently reported more poor mental health days compared to those with medium income and that average poor mental health days increased with age across both income groups. Additionally, we observed racial disparities in income distribution, with Black and Other/Multi-racial individuals being overrepresented in the low-income group. Education level was also strongly associated with self-reported health status, as respondents with less than a high school education reported significantly higher rates of poor or fair health compared to college graduates.

Several challenges emerged during our analysis. Early years of BRFSS data lacked derived variables such as _MENT14D, requiring manual derivation from original variables. Survey weighting methods changed in 2011, complicating comparisons across years. The survey's reliance on self-reported data introduces potential bias, and missing values for variables such as insurance status reduced sample sizes for certain analyses. Additionally, some variables were inconsistently measured across years, limiting longitudinal comparisons. These methodological challenges underscore the complexity of using large, longitudinal survey data for health disparity research.

Future work could expand this analysis by including more recent years of BRFSS data, integrating geographic variables to examine spatial disparities, or applying predictive modeling to forecast future trends in health disparities. Incorporating external data sources such as census income data or healthcare access metrics could enhance explanatory power. Another possible extension would be to analyze intersectional effects across multiple identities, such as the combined effects of race, gender, and education on health outcomes. Exploring how neighborhood characteristics, environmental exposures, and social capital interact with individual-level factors could further enrich our understanding of health disparities.

Beyond methodological extensions, future research could also focus on evaluating the impact of specific policies or interventions aimed at reducing health disparities. For example, tracking changes in disparities before and after Medicaid expansion, the Affordable Care Act, or state-level initiatives could provide insight into which strategies have been most effective. Qualitative research could complement these quantitative findings by exploring the lived experiences of individuals affected by health inequities, adding nuance and depth to the statistical patterns.

Our findings have practical implications for public health practice and policy. The persistence of disparities over nearly three decades suggests that interventions must go beyond individual behavior change to address upstream social determinants of health. Policies targeting income inequality, educational opportunity, and systemic racism are essential for reducing health inequities at the population level. Public health agencies can use data from surveillance systems like the BRFSS to prioritize high-burden groups, allocate resources equitably, and monitor progress over time.

In conclusion, while our study provides important insights, it also underscores the complexity of addressing health disparities. Systemic factors influencing health extend beyond individual behaviors and access to care, requiring multifaceted solutions that address structural inequities. As public health practitioners and policymakers continue to address disparities, analyses like ours can help guide priorities and resource allocation. By combining rigorous data analysis with a commitment to health equity,

future work can build on these findings to create more just and effective public health systems. Ultimately, the challenge is not merely identifying disparities, but acting on them. Only through sustained and systemic change can we hope to see a meaningful narrowing of the gaps that divide population health in the United States.

References

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