Indicators of Environmental Health Disparities
Age-adjusted Hypertension Technical Documentation

General Purpose of Indicators

These indicators align with EPA's strategic vision of evaluating its success in eliminating health and environmental disparities through clear and meaningful metrics. Using data from sources included in EPA's Report on the Environment (ROE) (U.S. EPA, n.d.), America's Children and the Environment (ACE) report (U.S. EPA, 2019), and other agency data sets, we provide data visualizations across years for which data are publicly available and discuss implications of the current indicators for highlighting disparities clearly and meaningfully over time.

Identification

1a. Indicator Title(s): Age-adjusted Hypertension

1b. Purpose of Indicator:

The purpose of this indicator is to show progress in eliminating disparities in cases of hypertension across SES levels and racial and ethnic groups.

Cardiovascular disease (CVD) refers to any disease involving the heart and blood vessels, like coronary heart disease and stroke (U.S. EPA, 2021). One in three Americans has a heart or blood vessel disease and CVD has been the leading cause of death in the U.S. all but one year since 1900 (U.S. EPA, 2021; U.S. EPA, 2015). Hypertension, a type of cardiovascular disease that leads to a prolonged increase in blood pressure, is a major risk factor for other CVD conditions like coronary heart disease and stroke. Risk factors for hypertension include obesity, physical inactivity, and high sodium consumption. (U.S. EPA, 2015). Traditional risk factors for CVD, like male sex, older age, increased blood pressure, high cholesterol, and smoking, account for about 50 percent of cardiac events. (U.S. EPA, 2014). Given this, there are also known environmental exposures that act independently or in conjunction with established risk factors to impact CVD and hypertension.

Lead exposure can lead to both cardiovascular effects and cardiovascular-related mortality. There is consistent evidence to show that lead exposure increases blood pressure in adults, hypertension, and cardiovascular mortality, with more limited information on lead relating to changes in heart rate variability and the development of atherosclerosis (U.S. EPA, 2024). Air pollution exposure has also been found to contribute to the development of CVD and hypertension and exacerbate existing CVD conditions.[3] Evidence is particularly strong for short-term and long-term exposures to fine particulate matter, or particulate matter with a diameter of less than 2.5 µm (U.S. EPA, 2019b). The relationship between other criteria air pollutants and CVD is still being investigated. (U.S. EPA, 2016).

In addition, the effects of climate change may cause or worsen certain illnesses and health conditions. Climate-related changes to weather and heat can worsen air quality by impacting ozone and particulate

matter concentrations, wildfires, and allergens (U.S. EPA, n.d.b). The effects of climate change on air quality pose human health risks, including heart disease and stroke. People with conditions such as hypertension are particularly vulnerable to the adverse effects of climate change on outdoor air quality (U.S. EPA, 2023).

Certain populations remain at a disproportionate risk for exposure and negative health outcomes. Those at increased risk of exposure to particle pollution include non-white and low-income populations, as well as those who live or work in urban and industrial areas (U.S. EPA, 2021). Elderly and other high-risk populations are also heavily impacted. Studies have shown exposure to ambient airborne particulate matter could be associated with increased hospitalizations and mortality among older individuals, largely due to cardiopulmonary and cardiovascular disease (American Lung Association, 2020).

Cardiovascular disease encompasses a range of conditions, including hypertension, heart disease, and stroke. This project does not seek to comprehensively analyze disparities in cardiovascular disease across a wide range of conditions; rather, for the sake of simplicity it seeks to illustrate these disparities in one condition, which may reflect broader trends. As such, this effort focuses solely on hypertension.

1c. Indicator Abstract:

This indicator describes data on hypertension across the U.S. for the time periods 2002 to 2018. Cardiovascular disease, which is the leading cause of death and disability in the U.S., may be partly caused or exacerbated by environmental exposures. This information helps to show how rates are changing over time, space, and subpopulations.

1d. Indicator Term Definitions:

Hypertension prevalence indicators are expressed as age-adjusted percentages

Data Information

2a. Unit of Measure: Age-adjusted prevalence of disease rate, in percentage

2b. Data Source:

The hypertension prevalence indicator is based on age-adjusted and age-specific data published by the Centers for Disease Control and Prevention's (CDC's) National Center for Health Statistics (NCHS) that report the results of a series of survey questions pertaining to selected circulatory diseases as part of its National Health Interview Study (NHIS) for the period 2002-2018. Hypertension prevalence data were obtained from annual reports and standalone tables published by CDC's NCHS, which summarize health statistics compiled from the center's NHIS (https://www.cdc.gov/nchs/nhis/nhis_series.htm).

2c. Data Collection:

The NHIS is the nation's primary source of general health information for the resident civilian non-institutionalized population of the United States and since 1960 has been one of the major data collection programs of the NCHS. The NHIS data for the reporting period (2002-2018) have been designed to produce reliable annual national estimates. The NHIS section on health conditions utilizes survey questions specifically designed to produce national estimates of disease prevalence. CDC collects cardiovascular disease prevalence data via a series of survey questions pertaining to selected circulatory diseases (i.e., "coronary heart disease [CHD]," "stroke," "hypertension," and "all types" of CVD) as part of its NHIS.

In separate questions, survey respondents were asked if they had ever been told by a doctor or other health professional that they had selected circulatory diseases: hypertension (or high blood pressure), coronary heart disease, angina (or angina pectoris), heart attack (or myocardial infarction), any other heart condition or disease not already mentioned, or a stroke. CDC's NHIS summary statistics separate out "all types" from "coronary heart disease." Coronary heart disease includes coronary heart disease, angina, and heart attack. Respondents had to have been told on two or more different visits that they had hypertension or high blood pressure to be classified as hypertensive. Respondents may be represented in more than one category (NCHS, 2019b).

The NHIS is a cross-sectional household survey, with sampling and interviewing conducted continuously throughout each year. The survey is designed so the sample scheduled for each week is representative of the target population, and the weekly samples are additive over time. The sampling plan follows a multistage area probability design that permits the representative sampling of households. The sampling plan was redesigned in 1995 to include the over sampling of certain populations to ensure adequate representation (e.g., Black and Hispanic persons), and to draw samples from each state (Botman et al., 2000). This oversampling occurred as part of the 1995-2005 survey design, and oversampling of Asians was added to the design for 2006-2015 (Parsons et al., 2014). The sampling plan was redesigned again in 2016 to account for changes in the distribution of the U.S. population and to remove procedures to oversample Black, Hispanic, and Asian persons at the household level (NCHS, 2019a).

The survey design facilitates the collection of NHIS data through the use of in-person interviews and state-level telephone health surveys. Although the NHIS sample is normally too small to provide state level data with acceptable precision for every state, there may be reliable estimates for several states (particularly when many years of data are combined) (NCHS, 2019a).

These data represent a comprehensive and reliable data set for measuring trends in CVD prevalence across the U.S. (nationwide and regionally), over time, and across subgroups (Botman et al., 2000; NCHS, 2019a; Parsons et al., 2014). The NHIS questionnaire was revised extensively in 1997. The revised NHIS questionnaire has "core" questions and "supplements." The core questions are largely unchanged from year to year and allow for trends analysis and for data from more than one year to be pooled to increase sample size for analytic purposes. The core questions contain four major components: household, family, sample adult, and sample child. The NHIS CVD questions are included within the sample adult component.

The response rate for the ongoing portion of the sample adult survey module has been between 74 and 85 percent from 1999 to 2018 (NCHS, 2019a). Response rates for special health topics (supplements) have generally been lower.

Standard documentation is available to support the underlying prevalence data. Complete program methodology (including a description of the survey and the survey methodology) can be found at:

https://www.cdc.gov/nchs/nhis/about_nhis.htm (Overview)
https://www.cdc.gov/nchs/nhis/methods.htm (Methods)
https://www.cdc.gov/nchs/nhis/1997-2018.htm (Survey description)
https://www.cdc.gov/nchs/nhis/nhis_questionnaires.htm (Questionnaires)

A detailed description of the underlying sampling procedures for the NHIS can be found in Botman et al. (2000) (for NHIS data collected up through 2005), Parsons et al. (2014) (for data collected from 2005 to 2015), and NCHS (2019a) (for data collected from 2016 to 2018).

Methodology

3a. Calculation Methodology:

Prevalence data are reported as frequencies and percentages of the U.S. population as presented for adults (age 18 and older) in NHIS summary health statistics reports and standalone tables. Hypertension prevalence indicators are expressed as age-adjusted percentages.

3b. Quality Assurance/Quality Controls:

NHIS data collection is conducted by the U.S. Bureau of the Census under an interagency agreement with NCHS. Interviewers receive extensive training, and their work is monitored through a quality assurance program. Quality assurance and quality control (QA/QC) information is provided in Botman et al. (2000), NCHS (2019a), and Parsons et al. (2014).

Analysis

4a. Reference Points:

This indicator does not have established reference points or thresholds.

4b. Comparability Over Time and Space:

Because a single interviewing staff work year-round to collect NHIS data from across the nation, this indicator should be fairly comparable spatially and temporally. However, under-diagnosis rates vary by demographic and have changed over time.

Prevalence data are generally comparable over space, as they are considered nationally representative. Data collection is standardized and generally consistent across the nation.

4c. Sources of Uncertainty:

The NHIS data are based on a sample of the population and are, therefore, subject to sampling error. Standard errors, which measure the variation that might occur by chance because the survey only includes a sample of the population, are reported to indicate the reliability of the estimates. CDC calculates estimates and standard errors using SUDAAN software, which takes into account the complex sampling design of the survey, using the Taylor series linearization method.

Standard errors are calculated and shown for all percentages in NHIS tables for CVD prevalence. Estimates with a relative standard error greater than 30 percent and less than or equal to 50 percent are flagged, and data users are advised to use these data with caution as they do not meet the standards of reliability or precision.

Another source of uncertainty is self-reporting or recall bias. Prevalence data reported in the NHIS are based on self-reported responses to specific questions pertaining to CVD and are subject to the biases associated with self-reported data. Self-reported data may underestimate the disease prevalence being measured if, for whatever reason, the respondent is not fully aware of his/her condition and/or diagnosis. Self-reporting biases may vary by demographic.

For more information, see Variance Estimation and Significance Testing sections in NCHS's summary health statistics reports up through
2012 (e.g., https://www.cdc.gov/nchs/data/series/sr_10/sr10_252.pdf (PDF)) and the Variance Estimation, Statistical Reliability, and Hypothesis Tests section in NCHS's Technical Notes for Summary Health Statistics Tables for 2013 and beyond
(e.g., https://www.cdc.gov/nchs/data/nhis/SHS_Tech_Notes.pdf (PDF)).

4d. Sources of Variability:

Disease occurrence may be influenced by age, sex, race/ethnicity, behavior, socioeconomics, geographic location, and other factors. This indicator presents data across age, sex, and racial/ethnic subgroups to explore potential disparities across one or more of these groups.

4e. Statistical/Trend Analysis:

Confidence intervals were not computed for this indicator due to the complexity of the NCHS survey design and calculation of confidence limits. NCHS recommends using a Korn-Graubard confidence interval for proportions (Korn and Graubard 1998).

A comparison of race/ethnicity subgroups was conducted to test significant differences between groups.

- This used asthma rates in 2018, the latest year of data. . The formula used was and was compared to a Z score of 1.96 for a test of significance at the 0.05 level. Findings were that
    - Non-Hispanic Black was significantly **higher** than the US average at the 0.05 level

- Asian was significantly **lower** than the US average at the 0.05 level
- Non-Hispanic Black was significantly **higher** than Non-Hispanic white at the 0.05 level

Data Limitations/Qualifications

Limitations to this indicator include the following:

1. Prevalence data reported in the NHIS are based on self-reported responses to specific questions pertaining to hypertension-related illnesses and are subject to the biases associated with self-reported data. Self-reported data may underestimate the disease prevalence being measured if, for whatever reason, the respondent is not fully aware of his/her condition.

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